A TEXT-BOOK

OF

MATERIA MEDICA

PHARMACOLOGY AND THERAPEUTICS

BY

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TO

THE MEDICAL STUDENTS OF THE UNITED STATES,

IN THE HOPE THAT IT MAY AID THEM IN ATTAINING A CORRECT KNOWLEDGE OF THE NATURE AND ACTION OF DRUGS AND THE RATIONAL TREATMENT OF DISEASE,

THIS WORK IS CORDIALLY INSCRIBED BY

THE AUTHOR.

PREFACE TO SIXTH EDITION.

I WOULD be unappreciative if I failed to take this opportunity to express my gratification at the continued popularity of this Text-book, as shown by the necessity for the publication of another edition. Therefore, I desire to thank the medical profession, and especially the teachers of materia medica and therapeutics in the many colleges in which the book has been used, for the hearty reception which heretofore has been accorded it.

The book is the fruit of some twenty years' experience in teaching therapeutics and clinical medicine, and many years of private and institutional practice. It has been my effort to embody as much as possible of this experience in a condensed, carefully classified, and usable form. Above everything else, I desire this book to be practical rather than theoretical. It is important not only that the student should acquire the largest amount possible of knowledge of the remedies which he expects to use in the practice of medicine, but also that this knowledge should be systematically and logically arranged, so that it may become immediately available. I believe that the classification which I have adopted particularly lends itself to that end, and that it will greatly facilitate the study of this important branch of medicine.

While the needs of the student have been kept in the foreground, I have not forgotten the demands which are made upon it by the practising physician. I have, therefore, endeavored to make the subject-matter as complete and as detailed as the size of such a work will permit, and to give special prominence to the therapeutic sections. In this field I have drawn largely upon my own experience, not forgetting the larger mine of current medical literature.

The study of the official remedies in this edition has been brought into accord with the Eighth Decennial Revision of the U. S. Pharmacopœia. All the official remedies are mentioned. In addition to these, a few non-official remedies that have been demonstrated to be of sufficient importance, as shown by their more or less widespread employment, have been accorded a place.

It is my belief that the unfortunate agnostic tendency toward medicinal therapeutics, and the prevalence of nostrum prescribing in the medical profession, are the natural and inevitable results of the neglect of therapeutics in our medical schools. Every effort should be made to intensify the students' interest in this branch and to render his knowledge not only more complete, but of a character to be readily put into practical application. If this book contributes to that end, I shall feel that it has accomplished its greatest purpose.

I desire to acknowledge the unfailing courtesy and patience of the publishers, and cordially to thank Dr. John C. Hollister, of Chicago, for his valuable contribution on the Opsonic Index.

G. F. B.

PREFACE.

The present work has been undertaken with the immediate object of supplying the student of medicine with a clear, concise, and practical text-book, adapted for permanent reference no less than for the requirements of the class-room.

The arrangement—embodying the synthetic classification of drugs based upon therapeutic affinities—the author believes to be at once the most philosophical and rational, as well as that best calculated to engage the interest of those to whom the academic study of the subject is wont to offer no little perplexity.

Should an intelligent and comprehensive understanding of Materia Medica and Therapeutics be facilitated by the author's treatment of the theme, the deductions derived from his experience as a practitioner and instructor will not have been committed to print in vain.

Special attention has been given to the Pharmaceutical section, which there is reason to hope will be found exceptionally lucid and complete. It has been deemed advisable, however, in the general work to include in the descriptive enumeration only such drugs as experience has proved to be of unquestionable value and are of standard and authoritative acceptance in general practice. In accordance with this plan, many new and comparatively untried remedies have been omitted, since, while of established efficacy in certain conditions, they are as yet too imperfectly known to warrant association with remedial agents bearing the sanction of exhaustive scrutiny. So, too, a few official drugs have been excluded because they are practically never used or are employed only in isolated instances.

It will be observed that "*Untoward Action*" and "*Poisoning*"

are treated under separate heads. By the former it is intended to record the effects of *medicinal doses* in developing certain symptoms dependent more or less upon individual susceptibility, not necessarily assuming the aggravated form incident to toxic doses, which exert a definite influence regardless of idiosyncrasy.

In giving the careful Latin accent and quantity of medicinal nomenclature (Foster), so far as practicable with the prosodial signs employed, the design has been to correct a prevalent disregard of proper pronunciation reflecting little credit upon those to whom a knowledge of the subject should be as exact as it is familiar. To the prescription-writer the appropriate Latin genitive, and in a few cases the accusative, will doubtless afford valuable assistance.

During the preparation of the work many important text-books, periodicals, etc. have been freely consulted, and from the U. S. Pharmacopœia chiefly, and from the National Dispensatory, have been adopted almost *verbatim* the "*Origin*" and "*Description and Properties*" of the various drugs under consideration.

In reviewing the progress of the present volume the author desires to express his cordial acknowledgments to Prof. Carl S. N. Hallberg, Ph. G., whose exhaustive contribution of "WEIGHTS AND MEASURES" and "PHARMACEUTICAL PREPARATIONS" cannot fail to lend permanent interest to the work; to Dr. Alfred C. Cotton, Dr. Wm. E. Quine, and Dr. James B. Herrick, for friendly suggestions; to Dr. D. Lee Shaw, Dr. Fred C. Zapffe, and Dr. Thomas J. Jackson, for assistance in compilation. To Mr. Storrow Higginson the author's personal thanks are due for his scholarly assistance in the revision of the text.

G. F. B.

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A TEXT-BOOK

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INTRODUCTION.

THE history of medicine since the earliest times is the record of a more or less continuous series of experimental researches, having for their paramount object a precise and comprehensive knowledge of the nature of disease and the practical application of remedial agents. The various "schools" which have arisen from time to time are philosophically co-ordinate, their fundamental principles being referable to one dominating thought—the art of healing.

It is scarcely practicable here, even were it necessary, to review in detail the separate doctrines which have obtained during the evolution of sectarian therapy. From the earliest ideas promulgated by the ancient priests of Æsculapius, through the subsequent era of Hippocrates, Theophrastus, and the Alexandrian school, influenced by the crude, misguided notions prevailing ere science emerged from its infancy; discernible in the Galenic and other tentative yet memorable systems, in the epoch of Paracelsus and the Monastic Medicine of the Mediæval period, and in the radical theories of Rasori and Roeschlaub which attended the development of the eighteenth and have left a passing impress upon the nineteenth century,—through all, the gradual acceptance of empiricism as a legitimate guide to therapeutic truth is manifest. Yet viewed with reference to their underlying animus, these varied expressions of scientific endeavor distinguishing the part are perceptibly linked with the ampler system which has emanated from the more rational methods of modern research.

The light of inductive reasoning and the marvellous progress in scientific knowledge which characterize the nineteenth century are a living appeal from the idealism of a less enlightened age. The release from tradition—anticipated in the labors of Bichat and others—to which later investigation owes so many signal triumphs has doubtless been profoundly affected by the realistic tendency of modern thought. It is to the startling advancement attained in the natural sciences, however, resulting in a chemical skill and in mechanical appliances of incomparable value, that we must look for the originating impulse which has inspired the therapeutic knowledge of the present day. It needs but little reflection to perceive the immeasurable superiority of actual acquirements over the vague, hesitating—though ardent and laborious—methods to which the theory and practice of medicine were so long subservient.

We have said that, considered in the larger sense, the history of medicine has been a harmonious rather than an intermittent development. It is not to be supposed that, in the evolution of so momentous a scheme as the formulation of a remedial system applicable to the extensive catalogue of human ailments, there should not have occurred spasmodic and ill-adjusted theories, crystallizing in many a strange *cultus*, which, if ineffectual in retarding the onward sweep of rational progress, has, it may be safely averred, worked incalculable injury to the cause of medical truth. Mesmerism, astrology, spiritualism, even theosophy, however incongruously conjoined, and similar vagaries have not failed to enlist among their votaries many enraptured, even noted, believers; nor is the mental strabismus with which they are afflicted amenable to any resource of rational treatment. We need, moreover, but contemplate the pitiable hallucinations which urge the pious pilgrimages to Marpingen, Lourdes, and Trèves, and the criminal negligence and incredible offence to reason which stultify the so-called "Christian Scientists" (as ironical a misnomer as language permits), to realize that miraculous cures still hold blighting yet potent sway over the minds of the ignorant and credulous. May not even the assumption of thaumaturgical powers be one day possible with those who arrogate to themselves a knowledge little short of omniscience, and to whose rudimentary intelligence the laws of nature convey no perceptible lesson? As from the sublime to the ridiculous, so from faith to fanaticism, it is but a step, after all.

It is appropriate here to emphasize the unfailing—nay, ever-

increasing—importance of therapeutics in its relation to the welfare of mankind. Especially imperative is this obligation in an epoch of unprecedented achievement in every department of science which contributes to the perfection of the healing art, in which general advancement medicine has borne no inconspicuous rôle.

The rapid advance of experimental science, however, applied to medical treatment, culminating in bacteriological discoveries of signal value to mankind, and the remarkable triumphs attending the development of operative surgery, have inevitably tended to disparage the equally noble and far more widely cultivated field of therapeutic science. This result is the more deplorable since it creates in the minds of the young and inexperienced an impression of contrast and divergence in departments of study naturally and indissolubly correlated. It is scarcely surprising that the marvels of the laboratory and the splendid achievements of the arena should possess for the tyro an entrancing interest. Yet it is to be borne in mind that the most brilliant triumphs of diagnostic and surgical skill might prove futile as the means of arresting disease were they not supplemented by the *course of treatment* which constitutes *therapy*.

It must be confessed that medical art has too often been discredited by professional incompetence, and consequent failure to effect the *cure* which with the laity is wont to form, however ignorantly, the only criterion of ability. In America especially—where from defective laws the widest latitude is given to incapacity and imposture—the lack of proper academical training is frequently the cause of serious consequences in practice, little calculated to enhance the popular confidence and esteem. It therefore behooves the student of medicine to master thoroughly the details of the remedial art, become practically conversant with physiological conditions and the manifold phenomena of morbid anatomy, and so familiarize himself with the varying indications of disease that in the presence of whatever malady, his diagnosis and treatment may command respect—not only from the laity, but, what is of far more consequence to him, from the profession.

It is almost superfluous to lay stress upon pharmaceutical knowledge as a powerful weapon in the armament of the medical practitioner. Yet no branch of therapeutic science has, perhaps, been more neglected than a practical acquaintance with the nature and uses of Materia Medica, their origin, potency, and characteristic value, as well as their physiological action, and the incompatible

and synergistic agents upon which their efficacy often largely depends.

Thanks to careful and competent training among pharmacists, the skilful preparation and dispensing of drugs relieve the physician of much responsibility; yet he should be keenly sensible of the fact that the larger share of public confidence is reposed in him, and by diligent study of the subject endeavor to command the minutiæ of pharmacology, holding himself morally accountable for errors quite possible in the druggist's dispensary. It may not be irrelevant to add that in all medical procedure a sympathetic yet perfectly controlled nature, ready tact, and sterling common sense are cardinal requisites to professional triumph, it being generally true, as was long since observed by Hufeland, that "successful treatment requires only one-third science and two-thirds *savoir faire*."

Finally, the author would counsel the utmost seriousness in the pursuit of a calling which might aptly be termed "Christian Science"—the power to alleviate human suffering by means of curative agents with which the laboratory of nature has been mercifully stored. There can be no loftier, more practical manifestation of love to men than is exemplified in the benignant effort to assuage the ills to which mortality is heir; nor can any devotion be more privileged and inspiring than that which softens the shock of disease, illumines the darkness of mental and physical distress, and from the débris of misfortune, vice, and heredity creates anew the image of divine perfection. It is this uplifting, consecrated zeal, akin to veneration for medical science, which has endeared to the world the masters of the profession—of which the same wise Hufeland said: "To him who fails to make a religion of the healing art it is the most cheerless, wearisome, and thankless labor upon earth; indeed, in him it must become the greatest frivolity and a sin." And for those—and they are many—to whom the material, possibly mercenary, aspect of their task appeals unduly it is enough to cite in rebuke the elevated maxim of Stigelius:

Non omnia quae suscipimus lucrum spectant.

[*Thunbergii Dissertationes.*]

PHARMACOLOGY AND GENERAL THERAPEUTICS.

Nature heals, physicians treat—is a truth of old that is constantly forgotten: always by the patient, who expects the patent medicine or the family doctor to *cure* her; frequently by the physician, who is often persuaded, against his better judgment, to believe in the supernatural when the mysteries of drug action are involved. A few propositions concerning the general action of the human body in its endeavor to heal itself may not be out of place in an introduction to a work on the practice and art of aiding nature's forces in the treatment of abnormal conditions.

It is a difficult task to express, in a few phrases, the general causes of disease, but the following general agencies may be considered:

1. *Trauma*, whether the result purely of accident, or brought about in the general struggle for existence.

2. *Parasites*, both microscopical and macroscopical, acting within and without the body.

3. *Poisoning* from plants and animals, broken down and decomposed food-stuffs, and poisonous gases taken into the respiratory tract.

4. *Bad hygiene*, unwise modes of living, including faulty nutrition, faulty modes of dress, eating, and housing, use or abuse of certain organs or their lack of use.

5. *Heredity*.—Here would be classified not only the directly transmissible diseases, as syphilis, but also those constitutional dyscrasiæ that conduce to premature break-down of some part of the human body.

In order to combat these various agencies the individual organs have developed a system of natural cure methods (" natural therapeutics ") that are of interest. These may be summarized briefly, following Kobert, in part, as:

1. Healing by regeneration. Among the lower animals the regeneration of a lost member is not infrequent, but in man it is unusual. In a sense, however, the healing of wounds as a part of

the inflammatory reaction is analogous to this process in the lower animals. The hypertrophy of one kidney, compensating for the loss of the other, and the establishment of a collateral circulation are illustrations of what Bachmann, in 1894, pointed out as the law of equivalent compensations.

2. Healing may be brought about by the exercise of an organ. Thus, the old-fashioned system of exposure to wet and weather develops, by exercise of the skin, an increased resistance to agencies that otherwise might react harmfully on the organism.

3. In the struggle against parasites it would appear that the body had developed an extensive array of protective agencies. Thus, antiseptic substances in the saliva, gastric juice, and bile are simple instances of this protective power against parasites from the outside. The doctrine of phagocytosis embodies the principle of the action of the white blood-cell in its office as a protective agent. In the body-fluids are found *alexins*, *antitoxins*, immunizing proteids that protect from the actions of poisons which may develop as a result of the life activities of these parasites should they obtain a foot-hold within the body—or even protect from poisons developed in the course of disturbed metabolism. Fever, so frequently regarded as an adverse sign in disease, undoubtedly serves in large part as a means of protection of the body—by killing the agents that have induced the rise in temperature.

4. Healing from certain poisons is brought about by vomiting and diarrhea, by rapid elimination through diuresis, or by excessive perspiration. Within the body a most interesting series of changes often takes place—thus, splitting up of poisons, their oxidation or conversion, or even fixation, into non-toxic products is a constant phenomenon. Thus even so powerful an alkaloid as morphine is said by Faust to be in part oxidized and perhaps used as a food-stuff. The chemical changes that take place in the liver have here their most potent activities, and the pathological chemistry of the twentieth century promises to throw much light on these complicated problems. Poisons also are compensated for by the process of adaptation (habituation), and are frequently rendered inert by the development of specific antitoxic substances. Thus specific anti-morphine bodies have been developed in the blood of some of the lower animals.

5. The physiological process of *rest* is an expression of nature healing. Loss of appetite is the indication not to eat. Pain calls for rest.

6. Healing by the casting off of a portion of the organism is a process of nature healing widely made use of in diseases among plants and the lower animals. Abscess formation, the limiting, by fibrinous exudates, of intraperitoneal irritants, and spontaneous gangrene of the extremities are well-recognized examples of such a type of nature's healing.

Treatment is something apart from healing, and in its broad sense comprises all those means, psychical or physical, which the practiser of the healing art has at his command by which he can hope to alter an abnormal condition in the individual he is called on to treat. Thus, nature calls into play the highest of her gifts, intelligence, to aid her in the work of self-preservation, and it is the function of the text-book to aid, in so far as it is able, to train that intelligence in the facts that experience has proved of value—in the present instance, in the fields of materia medica, pharmacodynamics, and therapeutics.

Pharmacology, from the broad point of view, is the science of drugs, and includes the various fields of medical botany, medical zoölogy, pharmacognosy, pharmacodynamics, and pharmacy. Within recent years, however, following the German school, its meaning has been restricted and made equivalent to **pharmacodynamics**, or the study of the effects of physical or chemical agencies on living organisms. It is in this sense that it is used in this work.

Materia Medica is the study of the source, constituents, chemical and physical characters of the organic and inorganic materials used for drugs in the practice of medicine.

Pharmacognosy is a division of materia medica, and includes the technical study of the crude materials from which drugs are derived. Its deliberation is limited to the animal and the vegetable kingdoms, but it is not a science with sharply defined boundaries, as it encroaches on so many avenues of knowledge—systematic botany, zoölogy, gross and minute anatomy, chemistry, and pharmacy.

Pharmacy is largely a chemical study. It deals with those manipulations by which the potent principles of drugs are rendered available for therapeutic purposes.

Therapeutics is the art and practice of treating abnormal bodily states; it is the application of the sciences of physiology, pathology, and nosology, and is the concern of the physician. A physician is an engineer who cannot construct but is skilled in conservation and repair. Therapeutics, then, has for its object the restitu-

tion to the normal, or, if such is impossible, the giving of comparative comfort to the invalid. Its range of activity, therefore, is extremely wide, and a combination of methods is necessary to the resourceful physician. The following general modes of treatment should be considered:

Suggestion Therapy.—There is little question that the oldest systematic form of therapeutics was a type of suggestion therapy. In the old type of "Temple Sleep" we find the earliest use of this form of therapy. Magnus[1] has shown that the earliest relations of religion and medicine were to be found in the "Temple Sleep" procedure. To the earliest Egyptians priest and physician were one. There were priests not physicians it is true, but no physicians who had not priestly functions. Throughout the entire Egyptian civilization this double function flourished and even passed on into the Grecian system, where it persisted for centuries. We all know that certain organs of the body were under the care of certain gods or goddesses—some singly, some having charge of many organs if not the whole body. The early Egyptian god, Thoth, had the digestion under his particular care, and it is said that this mythical personage invented the clyster pipe. Thus the modern formula, "Fear God and keep the bowels open," is apparently of prehistoric Egyptian origin. The rationale of much of this priest therapy was to sleep in the temple of the god overnight. There in the quiet and repose of the holy place, providing it were not too popular, the god would appear to the sick one in the form of a dream, and would designate the remedy needed. Modern clairvoyant quacks pursue the same method. No. 59 for colds, so extensively advertised, is said to have been devised in a similar manner.

This method of treatment, it is known, was not uncommon even as late as the time of the Roman emperors.[2] In the Greek temples all were allowed save those so hopelessly ill that it seemed foolish. The procedure for those patients admitted to the temple was for the priests to narrate the wonderful results to be obtained by the step which was to be taken; thus was desirable confidence imparted. Then various prayers and ceremonies were gone through with and certain sacrifices made; the sacrifice being the ancient analogue of the "fee." After the "preliminary" conditions had been complied with, the ancient priest, it may be observed, obtained his retaining fee in advance, those patients who were more

[1] "Relation of Medicine and Religion," *Culturgeschichtliche Bilder aus der Entwickelung des ärztlichen Standes*, 1890.

[2] Vide Suetonius and Vespasian. Vespasianus, 7, No. 20.

well-to-do were placed in front of the statue of the god on the skin of the sacrificed ram, while the poor were permitted to lie down on a bundle of rags in one corner of the temple. Great stress was then laid on the character of the dreams the patient would have as he slept, for the advice of the god would come in the dream. History has recorded some fearful and wonderful dreams. Æsculapius is said to have demanded 120 ounces of blood for one venesection. Aristides was put by the gods on a diet of raisins to cure what appeared to be neurasthenia from too much exhorting. It is significant that the ancient gods commanded their patients to go fishing, to go hunting and swimming, and frequent attendance of theatres was an urgent remedy. It was highly essential, in fact obligatory, that the priests should interpret the dreams.

The treatment of temple sleep was the result of a profound religious feeling, and it was carried out with great decorum and seriousness. Implicit and devout confidence in the gods was a *sine qua non.* Thus the temple sleep, separated from its religious accessories, is the prototype of the systematic treatment by suggestion, and this suggestion therapy strutting about in the garb of religion has remained an inseparable companion of the human race from the most remote times of Egyptian civilization up to the present day. With all peoples and at all times, even during our modern century, suggestion has been active in the garb of religion ; only that this religious garb has frequently changed according to altered religious and cultural ideas. Faith is one of the oldest therapeutic agencies of which anything is known. As Dr. Osler[1] has so well said, " Faith in the Gods or in the Saints cures one, faith in little pills another, hypnotic suggestion a third, faith in a plain common doctor a fourth. In all ages the prayer of faith has healed the sick, and the mental attitude of the suppliant seems to be of more consequence than the powers to which the prayer is addressed. The cures in the temples of Æsculapius, the miracles of the Saints, the remarkable cures of those noble men, the Jesuit missionaries, in this country, the modern miracles of Lourdes, and the wonder-workings of the so-called Christian Scientists are often genuine and must be considered in discussing the foundations of therapeutics." " Physicians use the same power every day. If a poor lass, paralyzed, apparently helpless, bed-ridden for years, comes to me, having worn out in mind, body, and estate a devoted family, and she in a few weeks or less by faith in me, and faith alone, takes up

[1] *Medicine of the Nineteenth Century*, 1901.

her bed and walks, the saints of old could not have done more." "The faith with which we work, the faith, indeed, which is available to-day in every-day life, has its limitations: it will not raise the dead: it will not put in a new eye in place of a bad one, nor will it cure cancer or pneumonia or knit a bone; but in spite of the nineteenth century restrictions, such as we find it, faith is a most precious commodity without which we should be very badly off."

Of the various forms of suggestive treatment it is not necessary here to treat. One form, treatment by hypnosis, is worthy of careful study, but its details are out of place here.

Heliotherapy, exposure to the rays of the sun, or, in Finsen's latest developments, to the activities of the x-rays; **aerotherapy**, or exposure to the open air, moist air, dry air, superheated air, etc. —both constitute modes of treating some forms of disease. Much might be said of **Climatotherapy**, the principles of which are not well understood. **Dietetic Therapy.**—This is also a method of antiquity. **Diet**—milk cures, vegetarian diet, meat diets, diets for obesity, for diabetes, etc.—has extreme practical importance, and its principles should be thoroughly mastered by the student.

Physicomechanical Therapy.—This includes a large number of useful procedures—**Kinesotherapy**, or massage and Swedish movements, from which the fantastical osteopathy has developed, is one of the most important. The Chinese and Japanese have used massage for a thousand years, and it constitutes one of their most important therapeutic procedures. Tissot, in 1780, brought the methods in use once more in Europe; Schebe, of Germany, in 1847, and Zander, of Stockholm, in 1865, brought the modern gymnastic procedures to a state of perfection.

Hydrotherapy, involving the use of heat and cold, with modified massage, has justly become a most important therapeutic procedure. E. F. C. Oertel, of Bayreuth, in 1765, and Preissnitz, in 1790, may be regarded as the founders of modern hydrotherapy. Its most useful applications are to be found in reducing temperature, in promoting sleep, and in neurasthenic and weakened nervous states, although its applications in one form or another are numerous. Tonsillitis, pharyngitis, conjunctivitis, abdominal pain, ovarian neuralgias, etc., are all benefited by hot applications.

Hypodermoclysis and *enteroclysis* are special forms of hydrotherapy which are of great value.

Electrotherapy.—Electricity is a potent agent in the treatment

of certain forms of disease. Within recent years more definite ideas have been gained regarding the mode of its action. Space does not permit of more than an indication of the merest outlines in this place, the student being referred to text-books on the subject (Jacoby, " Electrotherapeutics ").

In general, two types of current, galvanic and faradic, are employed both for diagnostic and for therapeutic purposes. The galvanic current is of constant flow, low intensity, and small in quantity. It has little influence in causing muscular contractions, but has marked chemical and thermal properties and promotes metabolism. The faradic current consists of alternating to-and-fro currents, is usually of high intensity, and has marked power to promote muscle contractility. The knowledge of the different modes of application should be gained from a good text-book.

In using electricity for diagnostic purposes it is advisable to use the minimum amount of current to produce a desired effect. The two sides of the body should be carefully compared, and the patient should be at rest. It is advisable to have similar electrodes, and they should be applied to corresponding areas on the well side and the supposedly diseased side.

The condition of muscular contractility is investigated in using the galvanic current by making and breaking the current. Under the influence of small to medium currents the normal reaction of a muscle should be that the *anodal closure contraction* is less than the *cathodal closure contraction*, thus, A.C.C. $<$ C.C.C. In a muscle that is just beginning to show signs of a loss of muscular contractility the A.C.C $=$ C.C.C., whereas if the *anodal closure contraction* is greater than the *cathodal closure contraction* the reaction is known as the *reaction of degeneration*, and is an evidence of disease. Reaction of degeneration must result from almost any extensive lesion of the peripheral motor neuron. It is found in extensive neuritis from toxic causes, alcohol, lead, zinc, carbon disulphide, mercury, malarial poisoning, etc., in acute anterior poliomyelitis or other disease involving the cells in the anterior horns of the cord ; it may also occur with extensive muscle disease.

From a therapeutic point of view electricity is having a constantly widening application. The use of the x-rays in lupus and in flat epitheliomata is as certain as it is marvellous, and the application of the Finsen phototherapy is but in its infancy. Electricity is widely employed as an irritant, caustic, and escharotic. In

paralyses of spinal and neuritic origin its properties of stimulating metabolism make it a highly desirable therapeutic measure. When combined with massage and infinite pains and tact, continued for long periods of time, seemingly hopeless paralyses may be very markedly relieved. Eternal persistency is sometimes the price of recovery. In sensory affections the static current often is of service. Mental suggestibility is here an important item, and the static machine lends itself very readily to much quackery. Galvanism is often very useful in relieving the deep-seated pains of sciatica and lumbago. By many, electricity is deemed of no value, and by others as a panacea for all ills. The truth lies in the means. In proper hands it is an exceedingly useful agent, but it has fallen very much in the estimation of the profession because of the great use made of electricity by the charlatan and professional parasites on that portion of society that so delights in being humbugged.

Toxicology.—Pharmacology and toxicology are in a sense the same. They represent quantitative variation only. All pharmacological action represents some variation from normal standards. When such variations reach a point where the distutbance of function threatens to be or is fraught with danger to the well-being or life of the organism, then the subject is suffering from the toxic action of such an agent.

Pharmacotherapy.—This includes the study of remedial agents proper or the use of drug substances. It considers the applications of the teachings of pharmacology to the treatment of abnormal body states. It naturally constitutes the most important branch of therapeutics.

It is not to be supposed that our present elaborate systems of pharmacotherapy have come into existence as they now are found. They have had a natural development, and the various methods have merged, the one into another. Certain arbitrary methods have received special names, such as Empirical, Specific, Statistical, Physiological, Rational Therapeutics, etc.

Empirical Therapeutics implies the application of remedies to which experience has ascribed certain specific properties irrespective of systematic value. It is not based upon experimental research, but rather upon formulæ established by the accumulation of isolated facts—empiricism—and practical observation, apart from theoretical reasoning and the relations of physiological phenomena as revealed by modern methods of investigation. Were

it possible to extend indefinitely the list of remedial agents so as to embrace the entire field of therapeutic knowledge, the empirical method might attain the dignity of an exact science. Such, however, is the complexity arising from the manifold, often contradictory, impressions drawn from human experience that for the evolution of a systematic scheme of therapeutics the empirical system must of necessity prove inadequate.

By *Specific Therapeutics* is meant a system of treatment that implies that certain diseases have certain definite antidotes. Thus, mercury and the iodides are specifics for syphilis, antitoxin for diphtheria, antivenin for snake-bite, etc.

Statistical Therapeutics implies a method of treatment that is the outcome of the experience of the results observed in a large number of cases under certain restricted lines of treatment. This method arrives at excellent results if sufficient numbers of cases of the same type can be observed, but disease processes vary so widely in different individuals that the statistical method alone is not unlikely to lead to error.

Physiological Therapeutics consists in the application of the strict interpretations of the pharmacodynamic action of drugs to diseased conditions. With increasing knowledge its principles will prove more and more applicable, but the inherent difficulties of interpretation of all biological phenomena will always make this method unsatisfying.

Rational Therapeutics is a term much in use, but it means simply an application of the various criteria, empirical, statistical, experimental, etc., in the treatment of diseased processes. The rationalist cares less for the name of the disease and more for the disturbance of general organic functions, not isolated symptoms, but group symptoms, which indicate some large functional disturbance.

On the General Action of Drugs.—Broadly speaking, the action of drugs is exerted either locally or systemically, whereas the effects which are known as *reflex action* occupy a middle ground between the two. Many drugs have only a limited action at the point of application, while others possess not only a local, but a systemic, action as well.

The action of drugs is fundamentally a question of protoplasm chemistry, but the investigations of the biologist have not yet reduced the interpretations of nature to a question of molecular physics; until they do, pharmacology will retain the words *irritation*, *stimulation*, *depression*, *paralysis*, and *death* of protoplasm.

Hueppe, in 1891, enunciated the doctrine that all remedies first, in small doses, produced an irritant and stimulating action in protoplasm, to be followed, when used in larger doses, by a depressing or paralyzing action, which might go on to death of the protoplasm acted on. Thus the effects of small and large doses were contrasted; the foundations of the homeopathic idea are closely related to this interesting phenomenon. It is not a universal phenomenon, however, and cannot be designated as a law, as Hueppe claimed. There are a large number of substances that in small and large doses have antagonistic effects, but the antagonism is by no means an equal one. Thus is it a familiar illustration that small doses of morphine increase mental activity by slight stimulation, whereas large doses depress and paralyze and bring about unconsciousness. The grade of excitement cannot at all be made commensurate with the grade of depression by making the doses smaller and smaller. Chloral acts as an irritant to the peripheral nerve-endings, although it depresses and paralyzes the central nervous system. Citations might be multiplied to show the host of inconsistencies and variations.

If such variations are found to be true for the action of drugs on the normal human body, how much more variable are the results of pharmacotherapy on the diseased organism. At times a given agent acts with less force on a diseased organ than on a healthy one; at times again with greater activity, and still further the action of a drug may vary widely in health and in disease.

At the present time the limits of present-day information offer but little hope for a better interpretation of these questions, and not only is the clinical side of the problem obscure, but the chemical side is equally uncertain. It seems that different chemical actions must be considered. Many compounds seem to react on protoplasm with a mutual disarrangement of the molecules; thus the action of strychnine is interpreted; others act on the tissues and are eliminated unchanged, and yet have probably altered the chemical character of the tissues acted on. Of late years, through the studies of followers of Nernst and Ostwald, an entirely new series of studies have been carried on which are destined to be closely related to the study of the physiological action of drugs. The study of electrolytic dissociation has already opened up new fields in physiology, and the ground is being broken in pharmacology. In the salts of the alkalies are found a series of actions differing from those already spoken of; here the active agent

induces changes in the watery content of the protoplasm or in the water of the liquids surrounding the cells, and brings about a series of physical, rather than chemical, changes. The familiar experiments of plasmolysis in the botanical laboratories illustrate this action, which is controlled by the general laws of diffusion of liquids, which are separated by animal or vegetable membranes.

In the animal body many salts are found in solution, not as complete molecules, but as made up of their electrical components, or *ions*, one positive and another negative, and when a chemical action takes place, it is an action not between the molecules of the salt and the protoplasm, but between an *ion* of the salt and the protoplasm, or even *ions* of the protoplasm molecule. For many of the simpler inorganic compounds, NaCl, KCl, KBr, KI, K(OH), many metallic salts, etc., the action of the *ions* is fairly well established. Thus the effects of strong, *hypertonic*, weak or dilute, *hypotonic*, and normal, *isotonic*, salt solutions on blood-cells, on muscle-cells, and on nerve-cells are well known and readily explicable under the now known laws of *ion* dissociation. Space does not permit of a more extended discussion of this interesting phase of the subject.

Physiological Action and Chemical Composition.—If the action of drugs is fundamentally a chemical one, then, on *a priori* grounds, it may be inferred that chemical compounds with similar dissociable *ions* will bring about similar physiological reactions. This general line of thought opens up a most fascinating field, which is daily offering more and more positive deductions, especially along the line of the newer synthetic preparations.[1]

Many years ago Blake suggested and worked out a complicated scheme of the toxicity of the metals, based on the periodic law of Mendeljeff,[2] but it would seem, for the present, that the time has not yet come when such relationships will prove of any practical interest.

In the field of organic chemistry, however, the fundamental truths of the relationships of chemical structure and physiological action have given to pharmacotherapy some of its most highly prized drugs. The ingenuity of the pharmaceutical chemist is being taxed to the utmost in the search for new compounds.

[1] See Fränkel, *Arzneimittel Synthese*, 1901.

[2] He showed that between certain limits there existed certain relations between the molecular weights, the spectrum analysis, and the physiological action of the metals.

Along other lines equal diligence has been shown. Thus, a large number of the newer synthetic remedies have their drawbacks: their action is marred by certain unpleasant by-effects that have no relationship to the main action of the drug. Many are too readily soluble and exert a local action on the stomach, when it is desired that they reach the intestines; others are insoluble and do not act where it is desirable to have them do so—as, for instance, many of the intestinal antiseptics and astringents. Many other illustrations might be instanced.

One of the most fascinating problems connected with this subject is that of the combination of the useful activities of different synthetics. Thus it is possible to combine a hypnotic acting radicle with an analgesic, and in one compound get a combination of the two. Other desirable combinations naturally occur. It is unfortunate that this problem has been often accomplished very satisfactorily from the chemical point of view, but when the physiological test has been applied, the compound has been worthless, both actions having been lost by some modification of one or the other main action.

The possibilities of the problems are extensive, but the difficulties are many. One warning note should, however, be sounded. Notwithstanding the many excellent results that have been accomplished by pharmaceutical chemists, there seems to be a tendency on the part of many to offer to the medical profession a vast number of *so-called* new synthetics. These are not at all new, but are well-known old compounds or very slight modifications of popular compounds that do not differ at all in their main actions. Such, by dint of extensive advertising and ingeniously devised "clinical reports," they force on the practitioner as very valuable *new* synthetics. Reference is not here made to the imposition of the compounding of well-known remedies, such as acetanilid, etc., and the putting forth of the same under proprietary names as *new* synthetic compounds. Such are the sharks that prey upon the legitimate pharmaceutical chemist who is making honest efforts to give the profession much-desired remedies. They also prey on the community in that, under the guise of a secret name, they commit economic robbery, supplying at exorbitant rates what can be supplied anywhere at rational prices.

Relation of Physical Chemistry to Pharmacology and Therapeutics.—Perhaps no departments of medicine have been so sub-

ject to the criticism "unscientific" as those of pharmacology and therapeutics. Pharmacologists still hold the most contradictory positions regarding the action of specific drugs; and therapeutists have at their disposal but few means which enable them to predict with definiteness the course of disease. Our modern therapeutic nihilism is undoubtedly the reaction of a thinking medical profession against an antiquated empiricism. But, as is customary with such reactions, the pendulum has swung too far backward. In order to restore it to its right position it is necessary that we reconstruct our knowledge of pharmacology and therapeutics, and, by beginning with its simplest problems, slowly rebuild it upon a basis of newer interpretations more in accord with modern science.

It is impossible, in this limited space, even to touch upon all the points at which physical chemistry offers immediate results in its application to the problems of pharmacology. In these pages, therefore, we shall consider only the applicability of the theory of electrolytic dissociation to the problems in hand.

According to the dissociation theory of Arrhenius, when strong acids, bases, or salts are dissolved in water (or certain other solvents), either all or a part of the molecules are split by the water into simpler substances—the electrically charged atoms or groups of atoms known as "ions." Since these strong acids, bases, and salts upon solution conduct the electric current, they are known as "electrolytes." According to Arrhenius' theory, then, a solution of hydrochloric acid is made up not only of HCl molecules, but also of H-ions and Cl-ions. Similarly, a solution of sodium hydroxide contains not only molecules of NaOH, but also Na-ions and OH-ions. Ions are charged with positive or negative electricity. The negatively charged ions, which travel to the positive pole, are termed "anions"; those charged with positive electricity, and traveling toward the negative pole, are termed "kations." Thus the ions of a completely dissociated hydrochloric acid solution may be written H^+ and Cl_-.

We cannot here bring forward even a few of the facts that go to prove the truth of the dissociation theory of Arrhenius; but there are an abundance of the same to show that the chemical (and consequently the physiological, pathological, and pharmacological) effects of most of the electrolytes are entirely dependent upon their constituent ions, and are independent of the nature of the molecules. For example: hydrochloric acid dissociates into H-

and Cl-ions; NaCl dissociates into Na- and Cl-ions. These solutions are the same in so far as they both contain Cl-ions, but different in that one contains H- and the other Na-ions. These differences determine the differences in the properties of the two solutions.

A single experiment may serve to fix more clearly the fact that it is, indeed, the *ions*, and not the molecules, that determine the activity of an electrolyte in solution. If an iron nail is put into an aqueous solution of HCl, the iron is immediately attacked and H is liberated. If, however, the nail is put into a solution of HCl in benzene, no such chemical action takes place. The water in the first case converts the HCl into H- and Cl-ions. Benzene has practically no such dissociating powers, and the HCl remains in the molecular state. The molecules of HCl are incapable of attacking the iron.[1]

It may, then, be accepted as true in general that the chemical characteristics of an electrolyte are dependent upon the nature of the ions contained therein. Thus the chemical characteristics of an aqueous solution of HCl are determined by the H- and Cl-ions it contains. All acids yield H-ions, and it is because of this fact that all acids have certain general properties. The differences between the solutions of two different acids that contain the same number of H-ions are determined by the differences between their anions. Since, now, the physiological effects of a substance are dependent upon its chemical nature, and since the chemical nature of an electrolyte is, in the main, dependent upon the nature of its ions, it follows that the physiological effects of an electrolyte are determined by the nature of its ions.

When an electrolyte is administered as a therapeutic agent, before it can produce any effect it must be in solution. Water is the universal solvent in the body. But when an electrolyte is dissolved in water, it is dissociated into ions. The therapeutic effects of such an electrolyte must, then, be dependent upon the ions which it yields. For example, in the administration of a dose of sodium iodide, we deal not with the effects of the NaI molecules, but with the effects of the Na- and I-ions into which the sodium iodide dissociates.

Although Dreser showed in 1894 that the relative toxicity of the mercury salts is determined by the number of Hg-ions that the salt yields upon solution in water, and although Kahlenberg

and True were the first to show that the poisonous effects of various electrolytes upon the roots of the bean are determined by the nature of their ions, the credit of recognizing the widespread physiological importance of the theory of electrolytic dissociation belongs to Jacques Loeb.

A series of papers originating from the laboratory of this investigator have brought proof of the following facts. The poisonous effects of acids and alkalies[2] upon muscle are determined by the number of the H- and OH-ions they yield, and is independent of the nature of the acid (in the case of the inorganic acids) or alkali. Another paper[3] shows that the amount of water absorbed by a muscle from equimolecular salt solutions is influenced not only by the laws of osmotic pressure, but also by the nature of the ions in the solutions. The absorption of water from equimolecular solutions of sodium, potassium, and calcium salts by muscle is analogous to the absorption of water by the Na-, K-, and Ca-soaps, for while muscle absorbs but little water in the sodium solution, it absorbs an enormous amount in the potassium solution, while it actually loses water in the calcium solution. A most important contribution to our knowledge of life phenomena is found in the discovery that Na-ions are absolutely necessary for the production of rhythmical contractions in voluntary muscle,[4] in heart muscle,[5] and in the contractile swimming bell of the medusa.[6] Yet a heart beating rhythmically in a pure sodium chloride solution soon comes to a standstill. If, however, a little calcium be added, the heart may continue to beat for hours.

What bearing, now, has the theory of electrolytic dissociation upon the problems of pharmacology? We have for years been accustomed to see the effects of different salts grouped under general headings. Thus we have become acquainted with the general effects of potassium and sodium salts, the salts of iron and lead, and the general properties of iodides and bromides. Never, however, has the question been asked, Why do these salts arrange themselves in such groupings? We have learned that certain salts having certain characteristics in common may at will be substituted for one another. We have known, moreover, that although certain groups of salts, such as the salts of Hg, Ag, Pb, Cu, etc., all have highly poisonous properties, yet that the fatal dose of the individual members of such groups differs greatly from one another. Then we have been impressed with the fact that many organic salts, or

salts combined with organic substances, are either entirely without effect, or else behave entirely differently from the ordinary salts. These are a few of the facts which become at once intelligible in the light of the dissociation theory.

We have said before that in the process of solution an electrolyte is dissociated, and that in consequence we deal, in the main, no longer with the properties of its molecules, but of the ions that constitute the molecules. We know, for example, that we can substitute, at will, sodium iodide for potassium iodide in order to produce certain therapeutic effects. These salts are alike in that they both yield I-ions; they differ in that the former yields Na-ions, while the latter yields K-ions. Any similarity manifested in the therapeutic effects of these two salts is determined by the similarity of their anions. But we know that the potassium iodide is much more depressant than the sodium salt. This is due to the direct poisonous effects of the K-ions upon muscle and nerves, an effect not exhibited by Na-ions. It is because all the iodides yield I-ions that they are grouped under a general heading. It is the effect of the I-ions that we seek in administering this drug in syphilis. Provided we give equal doses of I-ions, one salt may at will be substituted for the other. It is the secondary benign or deleterious action of the kations, however, which determines which salt we employ.

Similar reasoning applies to the bromides. We have long known of the hypnotic effects of the bromine salts and the specific effects of the bromides in epilepsy. These effects are due to the Br-ions, and one salt is as good as the other, provided it yields the same number of Br-ions, and its good qualities are not offset by a deleterious action of the kations. Experience with the bromides, moreover, brings to light the fact that it is indeed the *Br-ions* that determine the desirable effects of bromine compounds. Clinicians have long been acquainted with the fact that organic compounds containing bromine do not produce the effects given by the inorganic salts. This is because these organic compounds containing bromine do not yield any Br-ions at all, or because they yield only such small quantities as to be without effect in the doses administered. The same facts explain why manufacturers have been unsuccessful in producing an organic compound of bromine which could at all rival the ordinary inorganic salts.

The theory of electrolytic dissociation also explains why iron salts have certain general characteristics possessed by no other

salts, and why the salts of Hg, Ag, Pb, Cu, etc., are classed in groups by themselves. In these instances, however, the characteristic activity of the salt is determined by the kations, for the effects of the Hg-ions, Pb-ions, etc., evidence themselves long before the effects of the anions spring into prominence. In the cyanides, again, the anions are the effective agents and determine the characteristics of their group. KCN and HCN show similar effects, perhaps, because they both yield CN-ions, and these manifest their effects in doses so small that sight is lost of the K- and H-ions.

Several years ago Dreser[7] showed that the toxic effects of mercury salts are determined by the number of Hg-ions they yield upon solution. When mercuric chloride is added to albumin a precipitate is formed which can be readily dissolved in sodium thiosulphate, forming a so-called complex mercury salt. When the mercury exists in this complex form it loses its toxic properties, and even though equal weights of the metal be present, the complex salt is unable to inhibit fermentation; and frogs, fishes, etc., poisoned with it instead of the sublimate die more slowly. Dreser finds an explanation for these phenomena in the fact that the double salt is either not dissociated at all, or yields only a small number of Hg-ions. In cold-blooded animals the salt is slowly decomposed, and the toxic effects of Hg-ions formed poison the animal. In warm-blooded animals the decomposition occurs much more rapidly, and in consequence not much difference was found between the toxic effects of the mercuric salt and its more complex derivative. Yet all local irritative manifestations were lacking in the latter case.

There have recently appeared upon the market various organic compounds of silver (protargol, nargol, etc.) which have come into general use as substitutes for silver nitrate. It seems that these compounds exhibit all the beneficent and only a few of the deleterious qualities of silver nitrate. Undoubtedly an explanation similar to that given by Dreser holds here too. Silver nitrate owes its specific action to the Ag-ions it yields. The organic silver compounds probably yield none or only a small number of such ions. When, however, the organic compound is introduced into the body, it is decomposed, and the Ag exerts its specific effects to a degree dependent upon the number of Ag-ions liberated. These facts explain the differences in the behavior between the organic and the inorganic silver salts.

Paul and Krönig,[8] and, more recently, Scheurlen and Spiro,[9] have been able to show that the bactericidal power of solutions of electrolytes is dependent upon the ions contained in them. Equimolecular solutions of mercury salts arrange themselves according to their degrees of electrolytic dissociation in the following order: $HgCl_2$, $HgBr_2$, $Hg(CNS)_2$, HgI_2, $HgCy_2$. When arranged according to their bactericidal powers, the order is the same. This power is then dependent upon the number of Hg-ions contained in the solution. $HgCl_2$, which contains the largest number, has the strongest germicidal action, while $HgCy_2$, which is least dissociated, has the feeblest. So weak is the action of the cyanide that at a concentration four times that of a bichloride solution capable of destroying all cocci and spores it permits the development of several thousand colonies of the staphylococcus and many colonies of the anthrax bacillus. If K-ions are substituted for the Hg-ions by the substitution of KCl for $HgCl_2$ in the antiseptic solution, the germicidal powers of the solution are decreased, another fact which proves that the Hg-ion is the specific germicide. These facts effectively dispose of the conception of Behring, still held by many, that the bactericidal power of a mercurial is dependent upon the amount of *mercury* contained in it, and is independent of the nature of the compound.

The germicidal effects of silver and gold salts are similarly found to be dependent upon the Ag- and Au-ions. That it is, indeed, the ions which are thus effective is proved by the fact that solutions of $HgCl_2$ or $AgNO_3$ in absolute alcohol or ether (solvents in which but slight dissociation occurs) have no deleterious effect upon anthrax spores.

Recently Loeb[10, 11] has pointed out the influence of the valency and possibly the electrical charge of ions upon their toxic and antitoxic effects. Previous experiments had brought to light the poisonous character of a pure sodium chloride solution for the development of fish embryos, or on the beat of the heart. But these toxic effects are done away with when a small amount of calcium is added to the sodium chloride solution. Thinking that these were only special instances of a more general law, Loeb investigated the toxic and antitoxic effects of ions upon the development of the eggs of Fundulus, a marine fish. The eggs of this fish develop equally well in sea-water (their ordinary habitat), in distilled water, or in sea-water the concentration of which has been raised by the addition of NaCl. In a pure sodium chloride solu-

tion, however, of the same concentration as that of the sea-water, not a single embryo develops. If, now, a small though definite amount of a calcium salt be added, the poisonous effect of the NaCl solution is annihilated, and the eggs develop into embryos. Not only is calcium able to bring about this effect, but any bivalent kation serves the same purpose—Ca, Ba, Mg, Fe, Co, and even Zn and Pb. The nature of the anion is immaterial.

But these facts hold not only for the poisonous effects of a pure NaCl solution, but also for the poisonous effects of solutions of other salts, of univalent kations with univalent anions—LiCl, KCl, NH_4Cl. From these experiments, then, the general conclusion may be drawn that a small amount of a bivalent kation suffices to annihilate the poisonous effects of the pure solution of a salt composed of a univalent kation with a univalent anion. It has been further shown that a trivalent kation may at will be substituted for the bivalent kation, and that a much smaller amount of a trivalent kation (Cr, Al) suffices to annihilate the poisonous effects of a pure sodium chloride solution than is required of the bivalent kation. Finally, a quantitative relation exists between the amount of the toxic salt and the amount of a bivalent kation necessary to annihilate its poisonous effects. With an increase in the concentration of the pure NaCl solution there is a corresponding increase in the minimal amount of the bivalent kation necessary to do away with its toxic effects.

These facts are of the greatest biological significance and of the most wide-spread applicability. A preliminary note announces that the valency and possibly the electrical charge of ions influence in a similar way the toxic effects of pure salt solutions upon muscle. The effect of a calcium salt in overcoming the poisonous effects of a pure sodium chloride solution upon the rhythmical contraction of a heart muscle strip becomes at once intelligible as a specific instance of the above-mentioned general law.

Loeb's experiments give us an insight, moreover, into the method by which ions possibly influence protoplasm. Some time ago he pointed out the fact that in dealing with the properties of protoplasm we are dealing, in the main, with the physics of a colloidal solution in which are dissolved certain salts. The experiments of Hardy have demonstrated most clearly the influence of the electrical charge of ions upon the physical state of colloidal

particles. It requires a large amount of a univalent ion to cause the coagulation of a colloid, but a small amount of a bivalent, or a still smaller amount of a trivalent, ion will accomplish the same purpose. Loeb believes that similar facts may possibly underlie the toxic and antitoxic effects of the salts. If the electrical charge determines the antitoxic effects of a kation, then it becomes at once apparent why a small amount of a bivalent, or a still smaller amount of a trivalent, positively charged kation suffices to neutralize the poisonous effects of a pure sodium chloride solution.

The theory of electrolytic dissociation is only one of the many developments of physical chemistry that promises much if applied to the problems of pharmacology or the biological sciences in general. We must attribute a large part of our present ignorance concerning the general laws that underlie the action of drugs to the failure to recognize and utilize the fruits of this new science. Innumerable papers still appear in which the physiological, pathological, and pharmacological effects of percentage solutions of various electrolytes are compared. Only chemically equivalent solutions can be compared. It is to such violations of the simple laws of physical chemistry that many of the erroneous results obtained in the biological sciences are to be attributed.

The action of electrolytes must be analyzed into the action of their constituent ions. Ultimately we shall have a classification of the electrolytes based upon the action of the ions contained in them. Once we grasp the notion that the activity of a given substance is determined by the ions it yields upon solution we shall, perhaps, find a method of rearranging our system of dosage upon this basis—a process analogous to the regulation of the dosage of crude drugs based upon their alkaloid content.

REFERENCES.

1. See Fischer, *Medical Record*, 1901, March 30, where a review of the literature in its application to physiology and pathology is given in greater detail.
2. Loeb, *Pflüger's Arch.*, 1897, lxix., p. 1.
3. Loeb, *ibid.*, 1899, lxxv., p. 303.
4. Loeb, "Beiträge zur Physiologie," *Festschr. f. A. Fick*, 1899, p. 101.
5. Lingle, *Am. Jour. Physiol.*, 1900, iv., p. 265.
6. Loeb, *ibid.*, 1900, iii., p. 383.
7. Dreser, *Arch. f. exp. Pathol. u. Pharmakol.*, 1893, xxxii., p. 456.
8. Paul and Krönig, *Zeitschr. f. physik. Chem.*, 1896, xxi., p. 414.
9. Scheurlen and Spiro, *Münchener med. Wochenschr.*, 1897, xliv., p. 81.
10. Loeb, *Pflüger's Arch.*, 1901, lxxxviii., p. 68.
11. Loeb, *Am. Jour. Physiol.*, 1902, vi., p. 411.

MODES OF INTRODUCTION OF REMEDIES.

Remedies may be applied *externally* to the skin or *internally* to many mucous membranes, either as a *local* application or to bring about systemic action.

Methods of Skin Medication.—The passage of drugs through the unbroken skin takes place in a small degree only. The following methods are applicable: *Enepidermic method*, consisting of the application of cataplasms, fomentations, washes, vapor-baths, etc. *Epidermic methods*, or the methods of *inunction;* these are widely applicable. In such the drug is dissolved or suspended in some oily or fatty medium and made to penetrate the deeper layers of the skin by persistent and thorough rubbing. The thinner skinned portions of the body, such as the axillæ, groins, beneath the knee, and inner elbow surfaces are those most frequently used. The method is valuable for general absorption, especially in the mercurial administration for syphilis and in the use of methyl salicylate (oil of wintergreen) in rheumatism, but it lacks precision in dosage. *Endermic method*, by which the skin is blistered and the drug is applied to the free corium; it has many serious disadvantages.

Hypodermic Method.—This consists in injecting the drug into the subcutaneous tissues by means of the hypodermic needle and syringe. Since absorption by the tissues takes place readily, it will be seen that this method of application is far more efficacious than those previously mentioned. Not all drugs, it is to be observed, are available for administration by the hypodermic process of injection. The eminent success attending the operation, however, renders it of signal value to the physician.

This method was first used in a practical manner by Wood, of Edinburgh, in 1853. A syringe with glass rod and glass barrel accurately ground is the best now on the market. If carefully made, it will not leak and is never out of order. Those with metal barrels and leather washers dry out when not in constant use, and are never in condition when required. The all-glass syringe, moreover, can be sterilized at any time. This cannot be said of other varieties. A barrel holding about 30 minims is the usual size. After filling, all air should be excluded. The skin should be pinched up slightly, and the needle inserted rapidly and obliquely; some prefer to insert the needle at right angles, but this

is unnecessary, and if contaminated solutions should happen to be used, deep abscesses are produced. The insertion of the deltoid, outer aspect of the thighs, and deep muscles of the back are favorite sites. Solutions of drugs should not be used. It is preferable to use soluble hypodermic tablets; these are best dissolved in a teaspoonful of water heated over a flame; after cooling, the solution can be injected without causing pain. Prompt action follows this method, accurate dosage is assured, and disturbance of the gastric or intestinal mucosæ is avoided. As a rule, the dose by this method is 25 per cent. less than when given by the mouth.

Vaccination is a method of skin medication. In males it is best performed over the insertion of the deltoid, and in females there or at the upper outer portion of the leg. The thigh is troublesome to dress and necessitates greater exposure. For scarification the best instrument is a fine needle, which should be sterilized in a flame before using. The site selected should be cleansed thoroughly with soap and water; hard rubbing will aid in peeling away bacteria infected epidermis. Three or more scratches, $\frac{1}{8}$ of an inch apart and $\frac{1}{8}$ of an inch long, are then made, and the vaccine is rubbed in thoroughly either with a sterilized wooden toothpick or with the glass of a capillary tube. The capillary tube of glycerinated bovine lymph with a small balloon to expel the virus is the best form of virus now in use. With bovine virus the dangers from syphilis and tuberculosis are *nil*, and thorough cleansing of the arm avoids erysipelas or other septic infections.

Hypodermoclysis is a method of applying remedial agents through the skin. As a rule, 0.6 per cent. normal salt solution is used—a dram of table salt to a pint of boiled and filtered water. The site preferred is the anterior wall of the abdomen or the ilio-lumbar region, above the ilium and below the ribs. Thorough asepsis is necessary in the technic. An ordinary fountain syringe with a moderate sized needle is all that is required. The solution is best used at a temperature of from 110° to 115° F., and from 4 to 8 ounces are employed. The method is extremely useful in conditions of shock, hemorrhage, diarrhea, uremia, and in toxic states generally.

Local Applications to Mucous Membranes.—The Eye.— Here lotions (collyria) of boric acid or hot water are applied. Ointments and caustics are applied directly. Calomel may be dusted into the eye for sluggish chronic inflammatory conditions.

The Ear.—This is reached by direct application, or by means

of syringe. Alcoholic solutions of mild antiseptic drugs, such as boric acid, may be employed, the evaporation of the menstruum depositing the antiseptic in place. The ear is also reached by the Eustachian catheter from the inside.

The Nose.—Direct application of caustics or astringents can be made to the nose. Sprays and insufflations of antiseptic solutions or powders are useful. For children one of the most efficient methods of cleansing the posterior pharyngeal vault, which often is necessary in scarlet fever, measles, influenza, etc., in order to avoid middle-ear infection, is to let the little patient lie on his back, and, by means of a tablespoon, the antiseptic solution can be placed directly in the nose. Children will permit, even enjoy, this, when no amount of coaxing will persuade them to submit to the use of a spray. Moreover, a spray rarely cleanses the entire nasal cavity.

The Pharynx is reached best by direct application of absorbent cotton on an applicator. The applicator is made capable of being bent so as to reach the posterior pharynx. Solutions of cocaine, 4 per cent., and freshly prepared solutions of suprarenal gland, 10 to 50 per cent., are widely employed as local applications for anesthetic and astringent purposes in these localities. Gargles are now largely superseded by direct applications, sprays, or by syrupy or mucilaginous solutions containing astringent drugs.

Respiratory Tract.—As a means of producing anesthesia the respiratory tract has been utilized for some time. Opium is also taken in this manner by the opium-smoker. The confirmed cigarette inhaler also utilizes the respiratory tract. In young children breathing of steam, medicated or not, is an efficient means for treating spasmodic laryngitis, bronchitis, and bronchopneumonia. It is probable that the breathing of medicated vapors, as advocated by the disciples of the pneumatic cabinet, as a means of treating tuberculosis of the respiratory passages is largely illusory.

Rectum.—Medication as well as feeding by means of the rectum is indicated in conditions of great irritability of the stomach or under special circumstances, such as stenosis of the esophagus, gastric cancer with stenosis of the cardiac entrance, hysterical dysphagia, or in certain insane states, notably melancholia. Local disease may require local application of cautery, astringents, etc. By means of the proctoscope, enteroscope, or rectal specula, such topical applications may be made with ease and precision. Before making use of the rectal mucous membrane as a means for absorption it should be cleaned thoroughly. The alkaline reaction of the

mucus should be remembered in prescribing, else incompatibility may easily arise. Most drugs are absorbed much less rapidly through the rectal wall than through the stomach; there are, however, a few exceptions. These are notably strychnine, morphine, and iodine. Such is the teaching of many modern text-books. Personally, I have not been able to verify this.

Enteroclysis, or intestinal hydrotherapy, as one author puts it, is a method of intestinal irrigation, including the use of enemata, used for the relief of a variety of conditions. It is a highly valuable procedure. Any syringe will suffice, but for large quantities of water, the fountain or bag syringe is perhaps best adapted.

Large quantities of fluid may be thrown into the bowel—as much as 9 pints may be used. If the temperature of the fluid is high,—115°–118° F.,—there is less tendency to the development of intestinal cramps. When a large quantity of water is used to irrigate the bowel, its course may be followed by percussion, and its descent into the ascending colon noted. In this manner the cecum can be reached and thoroughly cleansed, a procedure of much value in the medical treatment of appendicular disorders. Normal salt solution may be used to subserve the same purposes as by hypodermoclysis.

Urethra.—Here direct application, irrigation, and suppositories afford the best means of medication. The cystoscope may be used here or for direct applications to the walls of the bladder.

Stomach.—Medication by means of the stomach is the most convenient and practical method. The passage through the mouth and esophagus does not alter, to any great extent, the principles of drugs. Some drugs, such as strong acids, must be well diluted in order to protect the mucous membrane of the mouth and the enamel of the teeth. The administration of certain of the metals requires caution. Thus, some of the soluble iron preparations alter the color of the teeth somewhat; lead acts injuriously if the teeth are carious; and when mercury is being administered, the hygiene of the mouth must be carefully watched. In the stomach many drugs that are insoluble or slightly soluble in water are rendered more soluble by the weak acids; many chemical reactions take place, which are further complicated as the drugs pass into the intestines and meet the alkaline fluids, the bile salts, and the products of intestinal digestion.

Intravenous Injection may be resorted to in desperate cases: its dangers are obvious, however, and, save for the purpose of trans-

fusion after severe hemorrhage, it can seldom be attempted with impunity.

Internal Administration.—The most obvious, and by far the most useful, method of internal administration is by the ***mouth;*** yet care and discretion are to be used even in so ordinary a process, and the physician should consider thoughtfully the time, consequent effects, and chemical changes, that the drug may produce the most beneficial results.

Inhalation is in many respects of the first importance as a method of internal administration. Its great facility in practice and its unquestionable efficiency—as in the case of anesthetics—render it readily available and highly beneficial, although the method has attained as yet only a limited use in therapeutics beyond a resort to it in pulmonary diseases.

Enemata.—A different class of administrative operations consists in injections into the rectum, which injections may be purgative, anodyne, nutrient, emollient, astringent, anthelmintic, etc. For speedy and efficient cleansing of the large intestine the purgative enema is of incomparable value, care being taken that the quantity of the injection be sufficient, that it be passed up as far as possible, and that it remain as long as the patient is able to retain it.

Nutrient enemata may be employed when, for any reason, the food cannot be made either to enter the stomach or to remain there. Small quantities—3 or 4 ounces—are retained better than larger amounts. As the mucous membrane of the rectum does not have any digestive power, such enemata should be predigested, either by peptic or pancreatic ferments. Milk, oatmeal, gruel, oysters, eggs and milk, peptonized, with mild alcoholic additions, as of sherry, make excellent nutrient enemata.

Another mode of securing beneficial results from internal administration through the absorptive properties of the intestine is by means of *suppositories*, readily introduced within the sphincter ani and dissolving at the temperature of the body. This method of medication is serviceable either for local or general purposes.

To take the place of intravenous injection, normal solution, 0.6 of 1 per cent., is used as an enema in all conditions where the former is indicated, especially after major operations. From 7 to 17 fluidounces (207–503 Cc.) are injected, according to the individual tolerance of the patient. These injections are to be repeated in the endeavor to secure the absorption of from 2 to 6 quarts (liters) of the solution in the course of twenty-four hours.

Conditions Modifying the Action of Remedies.—All individuals are not affected in the same degree by the same remedy. Age, size, weight, fatness or leanness, sex, temperament, etc., are some of the variants. These may be considered under the general head of dosage.

Dosage.—The term *dose* implies the quantity of a medicinal agent which under certain conditions it is advisable to administer. In other words, the therapeutic dose is that portion of a medicament which is capable of producing the required action. There are many considerations entering into the question, to be weighed by the features of the individual case. Dosage may be regarded as perhaps the most vulnerable point in therapeutic science, yet one upon which the art of healing almost wholly depends. While it yet seems advisable to state in a text-book the so-called *maximum* and *minimum* doses of various drugs, clinical experience has convinced me that the principle of the *maximum* and *minimum* should not be considered the true rule for dosage.

Common sense ought long since to have told us that the doses prescribed in the text-books are only based upon experience in certain cases, or upon experimentation made upon animals. From such data, however, the first author who wrote upon the posology of different substances started, and others have simply copied after the first. If any fact went beyond the well-defined limits, it was wont to be explained by the defective quality or method of preparation of the drug, or by an idiosyncrasy so rare that one would not even take the pains to investigate the matter and see if it were really less rare than had been believed.

Since Heller in 1755 enunciated his philosophical maxims touching the rational method of testing the therapeutic effects of drugs, eminent clinicians have sought to solve the mysteries attending the action of various remedies whose *modus operandi* remains to this day obscure. Indeed, so great is the diversity of operation pertaining to the commonest remedies, conditioned by the character and circumstances of the case, as well as the amount and quality of the drug, that it is next to impossible to predicate the precise effects of agents whose physiological properties are theoretically and even practically established. The ordinary adult dose of opium, for instance, is 1 gr. (0.06 Gm.); yet in certain diseases, such as peritonitis, ten times that amount may be required to relieve the pain. The doses given in many text-books differ materially from those prescribed in actual practice, being in-

tended to express only the average quantities to be administered, the exact amounts varying with the conditions of the particular case. These conditions may be classed under the heads of age, sex, temperament, idiosyncrasy, habit, state of the system, temperature of the body, time of administration, intervals between doses, cumulative action of the drug, and the contingent considerations of diet, climate, race, etc.—oftentimes a complicated problem even to the most skilful therapeutist. A few suggestions regarding the leading characteristics of dosage, as limited by these various circumstances, may be of value to the student.

The influence exercised by *Age* is indubitable, as a rule the young requiring smaller doses than adults, the very aged may be also very susceptible. With regard to children several mathematical formulæ have been devised, none of which, however, has proved infallible—least of all those based upon adult dosage, itself subject to no little uncertainty. Nor can deductions as to the efficacy of a given dose be drawn from the action of drugs with which the agent is naturally associated. A single drop of laudanum has been known to produce the death of an infant, whereas large doses of belladonna, conium, arsenic, and mercury have been taken with comparative impunity.

The most convenient rule (Young's) adds 12 to the child's age and divides by the age to get a denominator of a fraction whose numerator is 1, this fraction representing the proportion between adult and infant doses. Thus, for a child three years old $\frac{3+12}{3} = 5$, or $\frac{1}{5}$, the dose being one-fifth of that given to an adult.

Temperament acts as an important agent in modifying the effect of medicinal remedies, phlegmatic subjects readily tolerating certain medicines, such as opium, which those of nervous temperament are unable to bear. Stimuli act upon sanguine patents forcibly, yet upon others their influence may be either tardy or ineffectual. The condition is one which discloses a wide field of inquiry, the mental, moral, and physical tendencies of the individual being involved in the practical administration of medicines.

Closely allied to the foregoing is the question of *Idiosyncrasy*, the constitutional peculiarity which exerts a subtle influence, scarcely understood, as potent as it is obscure. Its characteristics cannot be formulated, but must be studied with the aid of experience—an odor, a taste, a casual or fixed impression, or hereditary instinct often determining their existence and manifestation. In tempera-

ment and idiosyncrasy, indeed, the psychological rather than the physiological side of therapeutics is developed, requiring for its treatment a professional acumen not always at command.

The influence of *Habit* is to diminish the susceptibility of the organism to impressions which under normal conditions would be speedy and effectual. Only by gradually increasing the quantity of the dose can results be obtained which in ordinary circumstances require few exhibitions. Thus, patients accustomed to the use of alcoholic stimulants accept heroic doses of alcohol with little or no indication of the effects quickly perceptible in temperate subjects.

Bodily condition obviously affects the action of remedial agents. It is well established that in severe pain opium may be administered in quantities which in a healthy organism would produce untoward, perhaps fatal, results. The salivation occasionally caused by mercury is seldom apparent in febrile conditions. Yet in cases where sensibility is diminished great care is necessary to avoid the deleterious effects of over-stimulation or excessive dosage.

Tolerance is closely associated with habit. There may be a specific tolerance of the nature of an immunity. Thus, rabbits are known to be very resistant to belladonna, hogs to snake venom, etc. Acquired tolerance is repeatedly seen for tobacco, alcohol, and opium, and certain recent studies have attempted to show that substances related to immune bodies are elaborated by the organism, thus in part explaining the phenomena of acquired tolerance.

Respecting *Sex*, although it is generally admitted that females require smaller doses than males, the exceptions to the rule are so numerous as almost to vitiate the accepted theory.

The *Time of Administration* is closely connected with the *Form of the Remedy* given, as a rule remedies being withheld immediately before and after meals. The practice, however, is subject to modifications, certain drugs acting best on an empty stomach, and others, such as local irritants, being more safely diffused when the stomach is full, in which case by mingling with the food they are not brought into irritating contact with the intestinal mucous membranes.

With regard to *Intervals between Doses* it may be said, in brief, that they are to be determined by the special features of the case, the character and potency of the drug, and the degree of tolerance and assimilation evidenced by the patient. Every remedial agent, under normal conditions, produces a specific and definite action, the system by absorption and elimination limiting the period of its efficacy in cases of prolonged treatment, so that the drug is evi-

dently to be renewed in order to secure perfect results. Failure to continue treatment has frequently proved disastrous, even fatal, to the patient, and it should be borne in mind that, in the absence of contraindications or untoward effects, a primary object of dosage is to create and maintain an impression upon the morbid system.

Repeated dosage with tardy elimination may lead to *cumulative action.* Thus, while dose for dose ethyl alcohol is more toxic than methyl alcohol, repeated doses of methyl alcohol are more highly poisonous, from slow elimination, than doses of ethyl alcohol. The chronic poisoning by the heavy metals, arsenic, mercury, or lead, is an illustration of a type of cumulative action. The iodides and bromides show similar phenomena. Digitalis is a classical example.

Other considerations—by some therapeutists held to be of minor, by others of paramount, importance—affect the vital question of dosage. The emotions, for example, play an interesting part in the toleration or rejection of remedial agents. Strangely enough, too, the imaginative faculty is often a cause of idiosyncrasy, numerous instances being adduced by reputable authorities wherein either positive or fancied ills were affected through the agency of spurious remedies—bread-pills, deceptive concoctions, and the like —the ethical aspect of therapeutics being here left to the conscience of the physician.

Pathological states are important modifiers of drug action. Thus, in chronic nephritis drugs which do not modify the kidney epithelium are used. Effort is made to obviate such activities. In high temperature the many synthetic antipyretics act very rapidly while having very little effect in health. In the case of parasitic diseases such as trypanosomiasis or malaria, the action of trypan-red or of quinine is naturally and entirely a different action than when given to a healthy person. In certain intestinal diseases associated with acid diarrhea, and with diminished alkalinity of the intestinal canal, the use of synthetic remedies which are only broken down into their constituent parts by alkalis is obviously useless.

UNTOWARD EFFECTS OF DRUGS.

Drugs given a specified patient, a victim of acquired or inherited defect, will produce in that patient unexpected results differing from their usual action. These results, which should not be

classified with typically poisonous effects or with those of prolonged use, may not appear in many cases, and do not correspond, as a rule, with the admittedly poisonous symptoms. They have been termed in Germany "nebenwirkungen," in France "inconvénients thérapeutiques," and among the English-speaking nations "untoward effects" and "bye-effects."

Untoward effects are of great interest from a medico-legal standpoint. Even physicians are but too apt to refer them to defects or impurities in the drug dispensed. They are seemingly multiform in character, and yet they can readily be ranged under a few general laws. The primary and secondary effects, which are often opposite in nature, the organs chiefly affected by the ordinary action of the drug, the method of drug-excretion, all play a part in what may be called general constitutional untoward effects, as contrasted with the untoward manifestations due to temporary and evanescent conditions, which last, however, also range themselves in a regulated fashion.

Prediction may be made with considerable accuracy as to the untoward effects of any drug on learning its action and all the factors cited. An antipyretic will have as untoward effects, skin-eruption because it is excreted through the skin, because the skin through its pores regulates temperature, and hence is under control of the central nervous system regulating temperature, and, finally, because the skin is in close connection from an early period with the nervous system. For the same reason profuse, debilitating perspiration often results. Since control of the temperature cannot be effected without control of the vasomotor system regulating the blood-supply, heart-failure, collapse, and palpitation may result, together with certain eye- and ear-symptoms.

The action on the heart may, by its influence on the kidney circulation, cause kidney and bladder symptoms even to the extent of albumin in the urine. If a remedy be excreted through the kidneys, albuminuria may present itself as an untoward result as is sometimes the case with ether. Alteratives and purgatives produce hemorrhages from the mucous membranes and swelling of those of the organs of special sense, beside skin-eruptions. Some hypnotics produce excessive perspiration, skin eruptions, vertigo, and heart collapse. Astringents cause diarrhea and bloody intestinal discharges. Diaphoretics cause pains at certain points from overstimulation. Pilocarpine causes at times pain in the penis; as there often occur in certain persons excessive secretion and plugged

sebaceous glands around its head, the pain and other resultant symptoms simulate chancre.

It will be observed from the annexed tables (see pages 52–57) that the most potent tonics and alteratives are most fertile in untoward effects. This is naturally to be expected. A drug of potent physiological action must of necessity try more severely inherited and acquired deficiencies of constitution than an inert drug. Too excessive strain on inhibitions weakened by acquired or inherited taint gives an undue sway to inhibited centers. Untoward effects of drugs may hence be conditioned on pre-existing affections of the inhibitory apparatus of the system.

One influence which, together with hereditary or acquired defect, plays a part in determining untoward results is what the Germans call the "etiologic moment." This is excellently illustrated in the neurotics, which display such decidedly variable untoward effects. In many neuroses nerve-strain of the eliminative and assimilative organs has produced toxins and other products; some of these naturally add to the effects of a given neurotic drug, or direct these in some special channel or inhibit certain effects, thereby giving others undue play. This may constitute, as Lewin has shown, a disposition that is but temporary, which disposition may have its foundation either in a greater abundance in the system of bio-chemical substances, which cause an unusually prompt solution or action of the medicines introduced, or which may unite with them to form injurious compounds; or it may be conditional on pre-existing pathologic changes in the inhibitory apparatus of the system.

The tables given on pages 52–57, covering all the departments of the materia medica, will give a better idea of these untoward effects than any detailed description.

TABLE I.

	GENERAL.	BRAIN AND CORD.	EYE, EAR, AND THROAT.	SKIN.	LIVER, KIDNEYS, AND BLADDER.
Arsenic	Fever, gastralgia, nausea, bulimia, salivation, profuse sweating, diarrhea, purpura.	Vertigo, ataxic symptoms, local anesthesia.	Eyelid edema, glottis edema, catarrh, amblyopia, tinnitus.	Vesicles, pustules, papules, erythema, urticaria, purpura.	Dysuria, icterus, hematuria, glycosuria, cystitis, albuminuria.
Chelidonium . . .	Nausea.	Vertigo.	Tinnitus.	Pruritus.	Albuminuria.
Cod-liver oil	Nausea.	Vertigo.		Vesicles.	
Colchicum	Nausea, gastralgia, like guaiac.	Like guaiac.	Like guaiac.	Vesicles.	Cystitis, strangury.
Columbo	Fever.	Vertigo, contractions.	Conjunctivitis, tinnitus.	Erythema.	Dysuria.
Cresole	Fever, nausea.	Vertigo.	Eyelid edema, tinnitus.	Erythema, papules.	Cystitis.
Gold	Fever, salivation, epistaxis.	Vertigo, emotional exaltation, aphrodisia.	Tinnitus.	Erythema, papules.	Cystitis.
Guaiac	Fever, profuse sweating.	Vertigo, ataxic symptoms, neuralgia.	Glottis edema, tinnitus.	Vesicles.	Cystitis, strangury.
Iodine	Bulimia, gastralgia, cardiac disorder, hemoptysis, dyspnea, fever, epistaxis, nausea.	Aphrodisia, ataxic symptoms, vertigo, delirium.	Amblyopia, catarrh, glottis edema, eyelid edema, diplopia, tinnitus, salivation.	Erythema, vesicles, papules, pustules, purpuric eruptions, urticaria.	Dysuria, cystitis, glycosuria, albuminuria.
Iron	Hemoptysis, hematemesis, nausea, gastralgia, fever, diarrhea, constipation.	Vertigo, ataxic symptoms, insomnia.	Eyelid edema, glottis edema, amblyopia, tinnitus.	Vesicles, purpuric eruption, pustules.	Hematuria, albuminuria, glycosuria, icterus.
Mercury	Fever, gastralgia, diarrhea, constipation, bulimia.	Insomnia, ataxic symptoms, insanity, local sensory troubles.	Eyelid edema, amblyopia, tinnitus, glottis edema.	Like iodides and quinine, tongue ulceration, salivation.	Dysuria, cystitis, hematuria, glycosuria.
Quassia	Nausea.	Vertigo, contractions.	Tinnitus.	Papules.	Dysuria.
Quinine	Fever, nausea, bulimia, hemoptysis, profuse sweating, dyspnea.	Delirium, insanity, ataxic symptoms, local sensory troubles, vertigo.	Amblyopia, photophobia, deafness, tinnitus.	Simulates scarlet fever, vesicles, papules, pustules, erythema, urticaria, purpura.	Hematuria, cystitis, albuminuria, glycosuria, icterus.
Salicylic Acid . . .	Profuse perspiration, bulimia, hemoptysis.	Vertigo, delirium, insanity, ataxic symptoms, local sensory troubles.	Dim sight, deafness, tinnitus.	Vesicles, pustules, pruritus, gangrene, purpura.	Cystitis, glycosuria, icterus.
Sarsaparilla	Nausea, gastralgia, bulimia, profuse sweat.	Vertigo, ataxic symptoms.	Glottis edema, tinnitus.	Eczema.	Cystitis, strangury.

Strychnine	Fever, dyspnea.	Vertigo, ataxic symptoms, local sensory troubles.	Conjunctivitis, photophobia, tinnitus.	Erythema, pruritus.	Albuminuria, glycosuria, cystitis.
Turpentine	Fever, nausea.	Vertigo, drowsiness, stupor.	Tinnitus.	Vesicles, erythema.	Albuminuria, cystitis, strangury, hematuria.

Table II.

	General. Lungs and Heart.	Brain and Cord.	Eye, Ear, and Throat.	Skin.	Liver, Kidneys, and Bladder.
Acetanilid	Cardiac failure, lung edema, cyanosis, fever, pallor, hyperidrosis, nausea, diarrhea.	Anesthesia, hyperesthesia, vertigo, delirium, stupor, ataxia.	Amblyopia, xerostoma, throat constriction, tinnitus, pupil irregularity, conjunctivitis.	Erythema, vesicles, papules.	Icterus, dysuria, cystitis, albuminuria, glycosuria.
Aconite	Nausea, diarrhea, salivation, hyperidrosis, collapse, cyanosis.	Vertigo, anesthesia, paresthesia, hyperesthesia.	Amblyopia, tinnitus, xerostoma.	Erythema, urticaria.	Icterus, polyuria.
Amyl Nitrite	Like glonoin.	Like glonoin.	Like glonoin.	Like glonoin.	Like glonoin.
Antikamnia	Like acetanilid.	Like acetanilid.	Like acetanilid.	Like acetanilid.	Like acetanilid.
Antipyrin	Cardiac weakness, pallor	Anesthesia.		Erythema.	
Arnica	Tenesmus, bradycardia, diarrhea, collapse.	Stupor, vertigo, headache.	Xerostoma, amblyopia, throat irritability.	Erythema, urticaria, papules, pruritus.	Cystalgia, dysuria.
Atropine	Like belladonna.	Like belladonna.	Like belladonna.	Like belladonna.	Like belladonna.
Belladonna	Diarrhea, nausea, vomiting, collapse, hyperidrosis, fever, cardiac pain, dysphagia, dyspnea.	Delirium, insanity, stupor, vertigo, ataxia.	Amblyopia, lachrymation, xerostoma, tinnitus.	Erythema, vesicles, papules, purpura, pruritus.	Cystalgia, dysuria, polyuria.
Bromides	Collapse, cardiac failure, lung edema, gastralgia, vomiting, aphrodisia, amenorrhea, pneumonia.	Delirium, insanity, stupor, ataxia, convulsions, anesthesia, hyperesthesia.	Throat anesthesia, coryza, laryngismus stridulus, conjunctivitis, amblyopia, myopia, diplopia, fetid breath.	Acne, papules, vesicles, urticaria, erythema, pruritus.	Dysuria, cystalgia, icterus, polyuria, glycosuria.
Caffeine	Bradycardia.	Delirium, insanity.	Diplopia.	Erythema, vesicles.	Dysuria.
Camphor	Diarrhea, collapse, aphrodisia, hyperidrosis, vomiting.	Delirium, insanity, stupor, hyperesthesia, headache.	Xerostoma, coryza, amblyopia, tinnitus.	Erythema, vesicles.	Dysuria, polyuria, cystalgia, strangury.

TABLE II. (*Continued*).

	General. Lungs and Heart.	Brain and Cord.	Eye, Ear, and Throat.	Skin.	Liver, Kidneys, and Bladder.
Cannabis Indica	Aphrodisia, vomiting, diarrhea, amenorrhea.	Vertigo, delirium, insanity, ataxia.	Amblyopia, tinnitus.	Erythema, vesicles.	Dysuria, cystalgia.
Chloralamid	Like chloral.	Like chloral.	Like chloral.	Like chloral.	Like chloral.
Chloralose	Like chloral.	Like chloral.	Like chloral.	Like chloral.	Like chloral.
Chloral Hydrate	Dyspnea, lung edema, heart-failure, fever, diarrhea, hyperidrosis, bradycardia.	Vertigo, ataxia, stupor, delirium, convulsions, analgesia, anesthesia, hyperesthesia.	Epiglottis edema, amblyopia, photophobia, conjunctivitis, choroiditis, tinnitus.	Erythema, acne, purpura, papules, urticaria, pruritus.	Icterus, dysuria, strangury, glycosuria, albuminuria.
Chloroform	Fever, collapse, aphrodisia, diarrhea, hyperidrosis.	Vertigo, delirium, ataxia.	Amblyopia, like chloral.	Like chloral.	Like chloral.
Cocaine	Anaphrodisia, collapse, diarrhea, constipation, nausea, fever, amenorrhea, tenesmus.	Vertigo, ataxia, hyperesthesia, delirium, insanity.	Like opium.	Like opium.	Icterus, strangury, dysuria, polyuria.
Codeine	See *Opium*.				
Conium	Nausea, vomiting, bradycardia.	Ataxia, stupor, hyperesthesia.	Amblyopia.	Erythema.	Dysuria, polyuria.
Digitalis	Cardiac failure, dyspnea, dysphagia, nausea.	Headache, vertigo, stupor, insanity, ataxia.	Amblyopia.	Erythema.	Dysuria, polyuria, strangury, glycosuria.
Duboisine	See *Belladonna*.				
Ergot	Nausea, vomiting, gastralgia, bradycardia, fever, cyanosis.	Convulsions, vertigo, ataxia, hyperesthesia, delirium, insanity.	Amblyopia, tinnitus, photophobia.	Erythema, papules, urticaria.	Icterus, glycosuria, strangury.
Ether	Pallor, cyanosis.	Vertigo, delirium.	Salivation, laryngismus stridulus, amblyopia, tinnitus.	Erythema, urticaria.	Icterus, glycosuria.
Exalgin	Like acetanilid.	Like acetanilid.	Like acetanilid.	Like acetanilid.	Like acetanilid.
Gelsemium	Dyspnea, coryza.	Vertigo.	Amblyopia.	Erythema.	Strangury, icterus.
Glonoin	Dyspnea, coryza.	Vertigo, ataxia, analgesia.	Amblyopia.	Erythema.	Strangury glycosuria.

Holocaine	Like phenacetin.	Like phenacetin.	Like phenacetin.	Like phenacetin.	Like phenacetin.
Homatropine	Like belladonna.	Like belladonna.	Like belladonna.	Like belladonna.	Like belladonna.
Hydracetin (like antipyrin).	Fever, nausea, cardiac irritability, dyspnea, nausea.	Vertigo, delirium, ataxia, numbness.	Pupil immobility, amblyopia, conjunctivitis, throat irritability.	Erythema, purpura.	Hematuria.
Hyoscyamus, Hyoscyamine, Hyoscine,	Like belladonna.	Like belladonna.	Like belladonna.	Erythema, papules, and pustules.	Icterus, bladder irritability.
Kryofine	Dyspnea, coryza, hyperidrosis.	Like hydracetin, except as to delirium.	Amblyopia.	Erythema.	Polyuria, dysuria.
Methylal	Like kryofine.	Like hydracetin, stupor.	Diplopia, amblyopia.	Erythema, urticaria.	Polyuria, bladder irritability.
Methacetin (like acetanilid).					
Monobromacetanilid	Fever, syncope, hyperidrosis, cyanosis.	Vertigo, stupor, headache, numbness, hyperesthesia.	Amblyopia.	Erythema.	Like methylal.
Musk	Nausea, aphrodisia, fever.	Like monobromacetanilid.	Throat irritability, amblyopia.	Erythema.	Dysuria.
Opium, Morphine, Codeine,	Nausea, diarrhea, gastralgia, dyspnea, aphrodisia, fever, hyperidrosis.	Vertigo, stupor, convulsions, insanity, headache, paresthesia.	Throat irritability, amblyopia, yellow vision, accommodation spasm.	Erythema, vesicles, papules, purpura, pruritus, urticaria.	Dysuria, glycosuria, icterus.
Paraldehyde	Like alcohol.	Like alcohol.	Like alcohol.	Like alcohol.	Like alcohol.
Pental	Like ether.	Like ether.	Like ether.	Like ether.	Like ether.
Phenacetin	Fever, collapse, dyspnea, hyperidrosis, cyanosis.	Vertigo, ataxia, stupor, hyperesthesia.	Amblyopia, tinnitus, diplopia.	Erythema, urticaria.	Dysuria, glycosuria, icterus.
Phenocol	Like phenacetin.	Like phenacetin.	Like phenacetin.	Like phenacetin.	Like phenacetin.
Physostigma	Nausea, gastralgia, vomiting.	Vertigo, mastalgia, delirium, ataxia.	Tinnitus, amblyopia.	Pruritus, erythema, urticaria.	Dysuria, icterus.
Phytolacca	Like physostigma.	Like physostigma.	Like physostigmin.	Like physostigmin.	Dysuria.
Pulsatilla	Coryza, dyspnea, cardiac irritability.	Orchialgia, mastalgia.	Amplyopia, eye-pain, tinnitus.	Erythema.	Dysuria, polyuria.
Scopolamine	Like belladonna.	Like belladonna.	Like belladonna.	Like belladonna.	Like belladonna.
Stramonium	Like belladonna.	Like belladonna.	Like belladonna.	Like belladonna.	Like belladonna.
Sulphonal	Like alcohol.	Like alcohol.	Like alcohol.	Like alcohol.	Like hematoporphynuria
Tetronal, Trional,	Like sulphonal.	Like sulphonal.	Like sulphonal.	Like sulphonal.	Like sulphonal.

TABLE II. (*Continued*).

	General. Lungs and Heart.	Brain and Cord.	Eye, Ear, and Throat.	Skin.	Liver, Kidneys, and Bladder.
Valerian	Nausea, diarrhea, aphrodisia, enteralgia, gastralgia.	Paresthesia, vertigo, delirium.	Throat constriction, tinnitus, amblyopia.	Pruritus, erythema, papules.	Dysuria, polyuria.
Veratrum (like aconite).	Collapse, dyspnea, cardiac pain, enteralgia, gastralgia.	Paresthesia, hyperesthesia, vertigo, convulsions, delirium.	Xerostoma, amblyopia.	Pruritus, petechiæ.	Dysuria.

TABLE III.

	General. Lungs and Heart.	Brain and Cord.	Eye, Ear, and Throat.	Skin.	Liver, Kidneys, and Bladder.
Aloes	Vomiting, tenesmus.	Ataxia, vertigo.	Amblyopia.	Erythema, urticaria.	Hematuria.
Ammonium Chloride	Nausea, diarrhea.	Ataxia, vertigo.	Amblyopia.	Erythema.	Polyuria.
Buckthorn	Fever, diarrhea.	Ataxia, vertigo.	Amblyopia, tinnitus.	Erythema.	Icterus, polyuria.
Cascara	Like buckthorn.	Like buckthorn.	Like buckthorn.	Like buckthorn.	Like buckthorn.
Castor Oil	Vomiting, fever.	Like buckthorn.	Like buckthorn.	Like buckthorn.	Icterus.
Colocynth	Like castor oil.	Like buckthorn.	Like buckthorn.	Pruritus, erythema.	Icterus.
Copaiba	Fever, dyspnea, gastralgia, nausea, aphrodisia.	Vertigo, ataxia, spastic palsy.	Amblyopia, photophobia, conjunctivitis, pharyngitis, tinnitus.	Roseola, urticaria, erythema, pruritus, penis ulcers.	Cystitis, nephritis, dysuria.
Croton Oil	Nausea.	Vertigo.	Amblyopia, conjunctivitis.	Erythema.	Icterus, cystitis, nephritis.
Cubebs	See *Copaiba*.				
Elaterium	See *Colocynth*.	See *Colocynth*.			
Gamboge	See *Colocynth*.				
Gratiola	Aphrodisia, vomiting.	See *Colocynth*.			
Ipecac	Diarrhea.	Vertigo.	Amblyopia, tinnitus, salivation.	Pruritus, erythema.	Dysuria.
Iris	See *Colocynth*.				
Jaborandi	Nausea, collapse, fever, lung edema.	Vertigo, ataxia, penis-tip pain.	Amblyopia, tinnitus.	Erythema, pruritus.	Icterus, dysuria, polyuria.

Jalap	See *Colocynth*.				
Male Fern	Nausea, fever.	Vertigo, ataxia.	Amblyopia, tinnitus.	Erythema, roseola.	Dysuria, cystalgia.
Podophyllum	See *Colocynth*.				
Pomegranate	Nausea, diarrhea.	Vertigo, ataxia.	Amblyopia, tinnitus.	Erythema.	Polyuria.
Pot. Chlorate	Nausea, diarrhea, fever.	Vertigo, delirium, ataxia.	Amblyopia, coryza, epistaxis.	Roseola, erythema.	Nephritis, icterus, cystitis, dysuria.
Rhubarb	Nausea, vomiting, constipation, penis hemorrhage.	Vertigo, ataxia.	Amblyopia, coryza, tinnitus.	Roseola, macules, erythema, urticaria.	Hematuria, dysuria.
Rhus	Nausea.	Vertigo, delirium, ataxia.	Amblyopia, deafness, tinnitus.	Macules, erythema.	Dysuria, cystitis.
Santonin	Nausea, diarrhea, gastralgia, amenorrhea.	Vertigo, ataxia, insanity, delirium.	Amblyopia, photophobia, yellow vision, tinnitus.	Erythema, urticaria.	Icterus, dysuria.
Senega	Nausea, diarrhea, gastralgia.	Vertigo.	Amblyopia.	Erythema.	Dysuria.
Squills	Like senega.	Like senega.	Xerostoma, amblyopia, coryza, tinnitus.	Erythema.	Dysuria, hematuria.
Tartar Emetic (antimony).	Nausea, cyanosis, collapse.	Vertigo.	Amblyopia, conjunctivitis.	Roseola, papules.	Nephritis, cystitis, dysuria.

CLASSIFICATION OF MEDICINES.

THE classification of drugs and remedial agents is a theme regarding which the many writers upon and teachers of medicine have shown a wider diversity of opinion, perhaps, than upon the physiological action and medical uses of individual remedies. The fact that therapeutics is far from being an exact science, and the rapid advance in our knowledge of normal physiological processes, of pathological conditions, and the systematic action of drugs, are sufficient explanation of the ever-changing judgments of our best observers concerning the action of certain medicinal agents under given conditions.

It follows that from time to time, as appears in reviewing the literature of the subject, different writers, in their attempt to keep pace with the advancement of knowledge, have devised various systems of classification.

In earlier days, when the therapeutist culled from the fields his simples for the cure of disease, there was naturally created a strong tendency toward a botanical classification. So far was the system pushed that in certain so-called schools of medicine the authority of Scripture was invoked, it being proclaimed as an axiom that "the leaves of the tree were for the healing of the nations" (Rev. xxii. 2). This eclecticism, strange as it may seem to-day, was the outgrowth of the Thompsonian or Botanical system of therapeutics. On the other hand, as an evolution of the old alchemic school, an attempt was made to found a classification by explaining the remedial action of all medicines upon a purely chemical basis.

With the advent of more modern methods of study, applied to the physiological action of drugs upon the animal economy, came the physiological classification, in which the effects of remedial agents were explained upon rational grounds.

It is hardly necessary to state that coexistent with these various endeavors to attain a philosophical method of classification, complicating them and perplexing their votaries, the dominating principle of empiricism held universal sway, setting at defiance in many instances the cardinal maxims of rational therapeutics, the rational therapeutist even to-day welcoming as a last resort the cruder, though often efficient, empirical method.

Some authors, perceiving the inutility of the older systems, have contented themselves with a mere alphabetical arrangement

of medicinal agents, regardless of their origin, natural affinities, mode of preparation, and physiological action.

Taking all the conditions into consideration, it seems the wisest plan for beginning students of medicine to so arrange the various drugs in use as far as possible along lines of therapeutic efficiency; and inasmuch as the trend of modern therapeutics is becoming more and more physiological, a combination of the physiological and therapeutic systems is here adopted. Many inconsistencies are inevitable in any classification, yet such a method of grouping is deemed the most satisfactory for students and practitioners alike.

WEIGHTS AND MEASURES.

The history of Weights and Measures affords a striking example of the incongruity resulting from the absence of a uniform standard of stable value to science, and must be regarded as the strongest argument in favor of the Metric, or Decimal, System.

An idea of the confusion prevailing under the old methods may be gained from an examination of their comparative units, by which we find that a pint is not a pound, an ounce not equal to a fluid-ounce, a drachm not equivalent to a fluidrachm, and a minim not commensurate with a grain. It was not until 1836 that the Secretary of the U. S. Treasury was directed by Congress to furnish each State in the Union with a complete set of revised standards, including the *troypound* of 5760 grains, from which the Apothecaries', or Troy, weight is derived, the latter term at present being applied only to the system used in weighing precious metals.

For commercial purposes the following Weights and Measures are employed:

Avoirdupois Weights: the Pound divided into 16 Ounces.

Liquid Measures: the "Wine Measure," of which the *U. S. Gallon* represents a volume of 231 cubic inches; each cubic inch of water at the maximum density (4° C.) being equivalent to 252.892 grains, the weight of a Gallon being therefore 58,418 grains. The Gallon is divided into 8 Pints (octarius), and the Pint is divided into 16 Fluidounces, each containing 8 Fluidrachms, or 480 Minims, the Fluidrachm containing 60 Minims. The signs used to designate these units are—♏, denoting minim or minims; fʒ, fluidrachm or fluidrachms; and f℥, fluidounce or fluidounces.

Apothecaries' (Troy) Weight.

20 grains (gr. *granum*)	= 1 scruple ℈ (*scrupulum*).
60 grains, or 3 scruples	= 1 drachm ʒ (*drachma*).
480 grains, or 8 drachms	= 1 ounce ℥ (*uncia*).
5,760 grains, or 12 ounces	= 1 pound ℔ (*libra*).

Apothecaries' (Wine) Measure.

60 minims (♏)	= 1 fluidrachm fʒ.
480 minims, or 8 fluidrachms	= 1 fluidounce f℥.
7,680 minims, or 16 fluidounces	= 1 pint O (*octarius*).
61,440 minims, or 8 pints	= 1 gallon C (*congius*).

This lack of uniformity in the units and the denominations of the three systems of weights and measures is exemplified in the subjoined table. While the two weight systems have a unit in common, the grain, there is no correlation in the higher denominations, ounces and pounds. The desirability of adopting a fixed standard, applicable in all cases where great accuracy in weights and measures is requisite, has been frequently emphasized by writers on therapeutics. As we have premised, the present difficulty forms a cogent argument in favor of the *metric system*, as wisely adopted in the U. S. Pharmacopœia. A remarkable disparity is shown in the liquid measures, in which there is no unit in common: a minim is not a grain, nor "a pint a pound the world around."

Illustrations.

1 ounce, avoirdupois,	=	437.5 grains.
1 ounce, troy or apothecaries',	=	480 grains.
1 fluidounce of water (the standard of volume)	=	455.7 grains.
1 pound, avoirdupois,	=	7000 grains.
1 pound, troy or apothecaries',	=	5760 grains.
1 minim of water weighing $\frac{455.7}{480}$	=	0.95 grains.
15 grains of water	=	16 minims.

(In the metric system, as seen below, there is but one group of weights, and these bear a definite relation to volume; for one cubic centimeter of water, the standard of volume, weighs exactly one gram.)

THE METRIC SYSTEM.

The Metric System of Weights and Measures, destined to supplant all others, originated with Prince de Talleyrand, bishop of

Autun, in 1790. Its almost universal adoption by civilized nations, its legality, though not compulsion, in England and the United States, and its adoption by the U. S. Pharmacopœia of 1890, require that it should be understood alike by the physician and the druggist. Save in the English-speaking world it is the only system used for governmental, statistical, and scientific purposes, and in the arts and manufactures its value has long since been recognized. Its extreme simplicity, its uniformity, and its facility of computation render it far superior to any other system of Weights and Measures, and it is highly probable that in the near future it will prevail in the transactions of every-day life, as it has already acquired international importance, and is in fact referred to as the International System.

The starting-point is the *unit of length*, the meter (*mètre*), which is the $\frac{1}{40000000}$ part of the earth's circumference around the poles. From this apparently irrelevant measure of length the *unit of capacity*, or volume, the *liter*, was established, it being the cube of $\frac{1}{10}$ of a meter. With equal simplicity and clearness, from the meter was derived the *unit of weight*, the *gramme*, which is the weight of that quantity of pure water at the maximum density, 4° C. (39.2° F.), which will fill the cube of $\frac{1}{100}$ part of a meter (cubic centimeter).

The Metric is also known as the *Decimal System*, because its multiples and subdivisions are obtained by ten (Lat. *decem*). The prefixes denoting *multiplication* are of Greek derivation, and are usually spelled with a capital letter: Deka 10, Hecto 100, Kilo 1000, Myria 10,000. *Division* of the units is indicated by Latin prefixes, not capitalized: deci $\frac{1}{10}$, centi $\frac{1}{100}$, milli $\frac{1}{1000}$. To distinguish readily one process from the other the word GILD has been aptly suggested as a mnemonic:

G	I	L	D.
Greek	increases,	Latin	decreases.

Contrary to a prevalent opinion, the Metric System is easily mastered. A perfect acquaintance with the metric tables is, naturally, indispensable, and the abbreviations for the different weights and measures should be thoroughly at command. For the rest, the system is simply that of arithmetical decimals, requiring chiefly a correct use of the decimal point. Only a tyro would read .065 *six and five-tenths hundredths* instead of *sixty-five thousandths;* so

Gm. .065 would never be read by one acquainted with decimals *six centigrams and five milligrams*, but *sixty-five milligrams*.

Metric Table of Lengths.

The measures of length employed in prescription writing are the millimeter, centimeter, decimeter, and meter.

10 millimeters	make	1 centimeter.
10 centimeters	"	1 decimeter.
10 decimeters	"	1 Meter.

1 millimeter	is written	1 mm.,	or	M .001,	equal	in inches to	.039370432,	approx.	$\frac{1}{25}$.
1 centimeter	"	1 cm.,	"	M .01,	"	"	.39370432,	"	$\frac{2}{5}$.
1 decimeter	"	1 dm.,	"	M .1,	"	"	3.9370432,	"	4.
1 Meter	"	1 M.,	"	M 1.,	"	"	39.370432,	"	40.

Metric Table of Capacities.

The only measures of capacity employed in prescription writing are the cubic centimeter and the liter. 1000 cubic centimeters (Ccm. or Cc.) make 1 Liter (L.).

Metric Table of Weights.

The weights employed in prescription writing are the milligram, centigram, decigram, gram, and kilogram. The other terms in the following table are but rarely employed abroad and never among English-speaking physicians. It will be seen that one Kilogram represents 1000 Grams.

10 milligrams	make	1 centigram.
10 centigrams	"	1 decigram.
10 decigrams	"	1 Gram.
10 Grams	"	1 Dekagram.
10 Dekagrams	"	1 Hectogram.
10 Hectograms	"	1 Kilogram.
10 Kilograms	"	1 Myriagram.

Abbreviations for the different divisions and multiples of the Gram, with their corresponding equivalents in grains, are as follows :

1 milligram	is written	1 mg.,	or	Gm. .001,	equal	in grains to	($\frac{1}{64}$)	.015432
1 centigram	"	1 cg.,	"	Gm. .01	"	"	($\frac{1}{6}$)	.15432
1 decigram	"	1 dg.,	"	Gm. .1,	"	"		1.5432
1 Gram	"	1 Gm.,	"	Gm. 1.,	"	"		15.432

In *writing* prescriptions a physician uses but one system, the metric or the apothecaries'; therefore to *write* prescriptions properly he does not need to know how to convert from one system to the other. He learns one system and adheres to that.

But to *read* and *understand* prescriptions written or spoken in the system other than the one he employs, he must translate them into his own system, and this requires a knowledge of equivalents. Knowing the approximate equivalents, it is then merely a matter of multiplication or division to convert a prescription of one system into a prescription of the other system.

Examples of conversion are:

1 *milligram* = $\frac{1}{65}$ grain: 5 milligrams = $\frac{5}{65}$ = $\frac{1}{13}$ grain.
1 *grain* = 0.065 Gm., therefore 2 grains = 2 × 0.065 Gm.
= 0.13 Gm., and $\frac{1}{100}$ grain = $\frac{1}{100}$ × 0.065 Gm.
= 0.00065 Gm., etc.
1 *ounce* = 30.0 Gm.: 4 ounces = 30.0 × 4 = 120.0 Gm.

The Approximate and Exact Equivalents of Weights, Measures, and Lengths in the Two Systems.

	Approximate.	*Exact.*
Weights—		
1 milligram, 0.001 (mg.).	$\frac{1}{60}$ or $\frac{1}{65}$ grain.	0.0154 grain.
1 centigram, 0.01 (cg.).	$\frac{1}{6}$ or $\frac{10}{65}$ grain.	0.1543 grain.
1 decigram, 0.1 (dg.).	1½ grains.	1.5432 grains.
1 gram, 1.0 (Gm.).	15 grains.	15.4324 grains.
30 grams, 30.0 (Gm.).	1 ounce.	462.9 grains.
31 grams.	1 ounce Troy or 480 grains.	478.4 grains.
1 grain (gr. j).	0.065 or 0.06 Gm.	0.065 Gm.
10 grains (gr. x).	0.65 or 0.7 Gm.	0.648 Gm.
15 grains (gr. xv).	1.0 Gm.	0.972 Gm.
1 scruple (℈j).	1.3 Gm.	1.296 Gm.
1 dram (ʒj).	4 Gm.	3.89 Gm.
1 ounce, troy (℥j).	30 or 31 Gm.	31.1 Gm.
1 ounce, avoirdupois (oz.).	28 Gm.	28.35 Gm.
Measures—		
1 cubic centimeter (c.c.).	15 minims.	16.23 minims.
1 liter (1000 c.c.).	34 ounces.	33.8 Cc.
1 minim (♏).	0.06 Cc.	0.061 Cc.
1 fluidram (fʒj).	4 Cc.	3.696 Cc.
1 fluidounce (f℥j).	30 Cc.	29.57 Cc.
1 pint (Oj).	480 Cc.	473.18 Cc.
Lengths—		
1 meter (m.).	40 inches.	39.37 inches.
1 decimeter (dm.).	4 inches.	3.937 inches.
1 centimeter (cm.).	0.4 or ⅖ inch.	0.3937 inch.
1 inch.	2.5 cm.	2.54 centimeters.

As these equivalents are only approximate, it is well to learn the foregoing "Table of Equivalents" and to avoid multiplying the equivalent of any term by too large a factor, for this likewise multiplies the error. For example: 6 centigrams are approximately 1 grain, but 60 grains are not *360 centigrams*, the error for the equivalent of 1 grain being multiplied sixty times; 60 grains are 1 dram, and the approximate equivalent of 1 dram is 4 grams or *400 centigrams*, a much larger figure.

N. B.—It is perfectly legitimate for a *physician* to use approximate equivalents, for in using equivalents he is merely translating, for his own understanding, prescriptions which have been already written. A *pharmacist* should not need to translate at all, because he should have at hand both the metric and apothecaries' weights and measures, and use whichever the prescription calls for.

PHARMACEUTICAL PREPARATIONS.

PREPARATIONS made by the pharmacist are called *pharmaceutical* preparations. Nearly one-half of the articles of the United States Pharmacopœia are pharmaceutical; formulas being given for their preparation, they are intended to be made in the pharmacy.

The commonly employed medical formularies are:

The Pharmacopœia (*pharmakon*, drug; *poiein*, to make), a book compiled by the government, or, as in the United States, a National Committee on Revision, and published by authority, establishing standards for the identification, purity, strength, and quality, and giving directions for the purification, valuation, preparation, compounding, and preservation of drugs, chemicals, and medicinal preparations. The United States Pharmacopœia is revised decennially, the present (eighth decennial revision) having become official on Sept. 1, 1905.

Official (Lat. *officium*, authority) drugs and preparations are those which are included in the Pharmacopœia—all others are *unofficial.* The term *officinal* (Lat. *officina*, a shop) was formerly applied to any drugs of recognized standard, but is now little used.

The National Formulary, a work published under the direction of the American Pharmaceutical Association, and designed to standardize the formulæ of such much-employed preparations as are not included in the U. S. Pharmacopœia.

Dispensatories.—These are compilations and commentaries on the pharmacopœias, and include the medical, physical, and chem-

ical history and nature of the various substances, directions regarding dosage and administration, and observations on their physiological action and therapeutics. They also contain information concerning drugs not accepted by pharmacopœial authority, yet which are of occasional use or interest. The Dispensatory is in effect a private publication and *unofficial*, in this respect differing essentially from a pharmacopœia. There are in the United States various works of this character, the United States and National Dispensatories being commonly in use.

The following are the abbreviations used to indicate which of these is the authority for any given formula, or which formula is intended when more than one go by the same name:

U. S. P.—United States Pharmacopœia.
B. P.—British Pharmacopœia.
P. G.—German Pharmacopœia.
N. F.—National Formulary.
U. S. D.—United States Dispensatory.
N. S. D.—National Standard Dispensatory.

The pharmaceutical preparations may be divided as follows:

I. Solutions.
II. Liquid Mixtures—Internal.
III. Extractive Preparations—Liquid and Solid.
IV. Mixtures of Solids—Internal.
V. Mixtures for External Use—Liquids and Solids.

These groups are each divided into a number of Classes, each class having a distinct Latin title by which its members, or individual preparations, are officially designated and alphabetically arranged in the U. S. P. In addition to the Latin and English titles, each class is also known by an English name, besides various synonyms. There are altogether 34 of these Classes official, besides a number unofficial.

	Official number.
I. The Solutions are divided, according to the character of the solvent, into—	
Aqueous: Aquæ—Waters	19
Liquores—Liquors (solutions proper)	25
Alcoholic: Spiritus—Spirits	20
Elixiria—Elixirs	3
Vina—Wines (by solution)	3

	Official number.
Saccharine: Syrupi—Syrups	29
Mellita—Honeys	3
Glycerin: Glycerita—Glycerites	6
II. The Liquid Mixtures—Internal:	
Misturæ—Mixtures (proper)	4
Emulsa—Emulsions	6
III. Extractive Preparations:	
Liquid:	
Aqueous: Mucilagines—Mucilages	4
Infusa—Infusions	3
Decocta—Decoctions	0
Acetous: Aceta—Vinegars	2
Vinous: Vina—Wines	7
Alcoholic: Tincturæ—Tinctures	63
Fluidextracta—Fluidextracts	85
Solid:	
Alcoholic: Extracta—Extracts	28
Resinæ—Resins	3
Semi-liquid:	
Ethereal: Oleoresinæ—Oleoresins	6
IV. Mixtures of Solids—Internal:	
Pulveres—Powders	9
Trituratio—Trituration	1
Sales effervescentes—Salts, effervescent	4
Confectiones—Confections	2
Trochisci—Troches	9
Massæ—Masses	2
Pilulæ—Pills	14
V. Mixtures of Solids—External:	
Liquid: Linimenta—Liniments	8
Oleata—Oleates	5
Collodia—Collodions	4
Solid: Unguenta—Ointments	24
Cerata—Cerates	6
Suppositoria—Suppositories	1
Emplastra—Plasters	7
Chartæ—Papers	1

AQUÆ MEDICATÆ—MEDICATED WATERS.

The Medicated Waters are solutions of volatile substances in Water. They comprise (1) the Aromatic Waters and (2) the Chemical Waters.

The *Aromatic Waters* are made by dissolving the volatile oils of their respective drugs, or distilling the latter with Water; two Waters are saturated solutions of other liquids than volatile oils—viz. Aqua Chloroformi and Aqua Creosoti. The following are official:

Aqua—		*Contains Cc. in 100 Cc., or percentage by volume.*
Amygdalæ Amaræ	bitter almond oil	0.1
Anisi	anise oil	0.2
Aurantii Florum Fortior	saturated	
Aurantii Florum	of the above	50.
Camphoræ	camphor	0.8
Chloroformi[1]	saturated	
Cinnamomi	cinnamon oil	0.2
Creosoti	creosote	1.
Fœniculi	fennel oil	0.2
Hamamelidis	made by distillation	
Menthæ Piperitæ	peppermint oil	0.2
Menthæ Viridis	spearmint oil	0.2
Rosæ Fortior	saturated	
Rosæ	of the above	50.

The *Chemical Waters* are solutions of gases in Water. The following are official:

Aqua—		*Contains gas, percentage by weight.*
Ammoniæ	NH_3	10
Ammoniæ Fortior	NH_3	28
Hydrogenii Dioxidi (Hydrogen Peroxide)	H_2O_2	3.

LIQUORES—SOLUTIONS.

The Solutions (also termed *Solutio, -nes,* Lat.) are solutions of non-volatile substances in Water.

The official Solutions are all solutions of inorganic salts. They are made either by simple solution (dissolving the particular salt in

[1] Chloroform Water, aside from its medicinal properties, is an efficient preservative agent, and forms a good solvent in place of water for preparing solutions intended to be kept free from micro-organisms, as, for example, those for hypodermic use.

Water) or by chemical solution (reacting upon different substances, and obtaining the newly-formed salt in solution in the Water). The following are official:

The *Arsenic Solutions:* these are all of the same strength—viz. 1 per cent.; 3 minims (0.2 Cc.) represent $\frac{1}{30}$ grain (0.002 Gm.) of arsenic, the average dose:

Liquor—		Percentage or Gm. in 100 Cc.
Acidi Arsenosi	acid, arsenous	1.
Arseni et Hydrargyri Iodidi	arsenic iodide	1.
(Donovan's Solution).	mercuric iodide	1.
Potassii Arsenitis	potas. bicarb. 2; arsenic trioxide	1.
(Fowler's Solution)	comp. tinct. lavender	3.
Sodii Arsenatis	sodium arsenate	1.

The *Alkaline Salt Solutions*, prepared by saturating an organic acid with an alkaline carbonate or bicarbonate, furnishing an agreeable and refreshing potion (also designated *Saturatio*, *Potio*, Lat.) charged with Carbonic Acid Gas. The *dose* is from 2 to 4 fluid-drachms (8–15 Cc.), except Liq. Magnesiæ Citratis:

Liquor—		Gm. in 100 Cc.
Ammonii Acetatis (Spiritus Mindererus)	ammon. carb.	5.
	acid. acetic. dil.	100.
Magnesii Citratis	magnes. carb. 15.; acid. citric.	33.
	potas. bicarb. 2.5; syrup.	
	acid. citric. 60 Cc.; aqua ad	350.
Potassii Citratis (Neutral Mixture)	potass. bicarb.	8.
	acid. citric. 6.; aqua ad	100.

The *Iron Solutions*, containing *ferric* salts in the following proportions by weight:

Liquor—		Gm. in 100, or percentage by weight.
Ferri Chloridi	ferric chloride	29.
Ferri et Ammonii Acetatis	liquor ammon. acet.	50.
(Basham's Mixture).	acid. acetic. dil. 6; tr. ferri chlor.	4.
	elix. arom. 12; glycerin 12; aqua ad	100.
Ferri Subsulphatis (Monsel's)	ferric subsulphate 13.57 per cent. of metallic Fe	
Ferri Tersulphatis	ferric sulphate	36.

The *Alkali Solutions:*

Liquor—		Percentage by vol. or weight.
Calcis (Lime Water)	calcium hydroxide	0.14
Potassii Hydroxidi	potassium hydroxide	6.
Sodii Hydroxidi	sodium hydroxide	5.6
Sodæ Chlorinatæ (Labarraque's)	chlorine	2.4

The *Solutions of Metallic Compounds;* used only externally:

Liquor—		Percentage by vol. or weight.
Hydrargyri Nitratis	mercuric nitrate	60.
Plumbi Subacetatis	lead subacetate	25.
Plumbi Subacetatis Dilutus	of above solution	4.
(Lead Water)	distilled water to	100.
Zinci Chloridi	zinc chloride	50.

The *Antiseptic Solutions:*

Liquor—		Percentage by vol. or weight.
Antisepticus	boric acid 2; benzoic acid 0.1; thymol 0.1; eucalyptol 0.025; oil of peppermint 0.05; oil of gaultheria 0.025; oil of thyme 0.01; alcohol 25.; purified talc 2.	
Chlori Compositus	chlorine	0.4
Cresolis Compositus	cresol	50.
Formaldehydi	formaldehyde	37.

Also,

Liquor Iodi Compositus (Lugol's Solution) potass. iodid. 10; iodine 5.

Liquor Sodii Phosphatis Compositus . sodium phosphate 100.

Unofficial Liquors of the National Formulary.

Liquor—

ACIDI PHOSPHORICI COMPOSITUS (Acid Phosphates).

ALUMINI ACETATIS (Alumini Acetici, Ph. Ger.).—Contains 8 per cent. of basic Aluminum Acetate.

ALUMINI ACETICO-TARTRATIS.—Contains about 50 per cent. of dry, so-called Aluminum Acetico-tartrate, which may be obtained by evaporating the solution.

AURI ET ARSENI BROMIDI.—Ten minims contain $\frac{1}{32}$ grain (0.002 Gm.) of Tribromide of Gold and $\frac{1}{16}$ grain (0.004 Gm). of Tribromide of Arsenic.

Liquor—

BISMUTHI.—Each fluidram (4 Cc.) represents 1 grain (0.06 Gm.) Bismuth and Ammonium Citrate.

BROMI (Smith's Solution of Bromine).—Bromine, 20 per cent.; Potassium Bromide, 10 per cent.; Water.

CALCIS SULPHURATÆ (Solution of Oxysulphuret of Calcium; Vlemingkx's Solution or Lotion).

CUPRI ALKALINUS (Fehling's Solution).

I. *The Copper Solution.*

Copper Sulphate, pure	grains	505 . .	34,639 Gm.
Distilled Water . . enough to make	fluidounces	16 . .	500 Cc.

II. *The Alkaline Solution.*

Potassium and Sodium Tartrate . .	grains	252 . .	173 Gm.
Sodium Hydroxide (U. S. P.) . .	troy ounces	2 . .	60 Gm.
Distilled Water . . enough to make	fluidounces	16 . .	500 Cc.

Keep both solutions, separately, in small well-stoppered vials, in a cool and dark place. For use, mix exactly equal volumes of both solutions by pouring the copper solution into the alkaline solution. Ten Cc. of the mixture prepared by metric weight and measure correspond to 0.05 Gm. of glucose. Of the mixture prepared by apothecaries' weight and measure, 210 minims correspond to 1 grain of glucose.

ELECTROPOEICUS (Battery-fluid).

A. *For the Carbon and Zinc Battery.*—I. (For ordinary use).—Potassium Bichromate, in powder, 6 troy ounces (180 Gm.); Sulphuric Acid, commercial, 6 fluidounces (180 Cc.); Water, cold, 48 fluidounces (1400 Cc.).—II. (For use with the galvano-cautery).—Sodium Bichromate, in powder, 6½ troy ounces (185 Gm.); Sulphuric Acid, commercial, 14 fluidounces (420 Cc.); Water, cold, 48 fluidounces (1400 Cc.).

Pour the Sulphuric Acid upon the powdered Bichromate and stir the mixture occasionally during one hour. Then slowly add the Water. Sodium Bichromate is more soluble than the Potassium Salt, and also much cheaper. When it cannot be obtained, the Potassium Salt may be substituted for it, weight for weight.

B. *For the Leclanché Battery.*—Ammonium Chloride, 6 troy ounces (180 Gm.); Water, enough to make 20 fluidounces (600 Cc.); dissolve the Salt in the Water.

FERRI OXYSULPHATIS (Oxysulphate of Iron).

FERRI PROTOCHLORIDI (Solution of Ferrous Chloride).—Each fluidrachm (4 Cc.) represents about 20 grains (1.3 Gm.) of Protochloride of Iron (ferrous chloride).

HYDRARGYRI ET POTASSII IODIDI (Solution of Iodide of Mercury and Potassium; Channing's Solution).—Red Mercuric Iodide, 72 grains (5.0 Gm.); Potassium Iodide, 56 grains (3.8 Gm.); in Distilled Water, 16 fluidounces (450 Cc.).

Liquor—

HYPOPHOSPHITUM.—Each fluidrachm (4 Cc.) contains 2 grains (0.12 Gm.) of Calcium Hypophosphite, 1¼ grains (0.75 Gm.) of Sodium Hypophosphite, and 1 grain (0.06 Gm.) of Potassium Hypophosphite.

IODI CARBOLATUS (Boulton's Solution; "French Mixture").—Comp. Tincture of Iodine, 110 minims (7 Cc.); Carbolic Acid, 40 grains (3.0 Gm.); Glycerin, 2½ fluidounces (100.0 Cc.); in 16 fluidounces (450 Cc.).

IODI CAUSTICUS (Iodine Caustic; Churchill's Iodine Caustic).—Iodine, 1 troy ounce (31 Gm.); Potassium Iodide, 2 troy ounces (63 Gm.); in Water, 4 fluidounces (120 Cc.).

MAGNESII BROMIDI.—Each fluidounce (30 Cc.) contains about 7 grains (0.5 Gm.) of Magnesium Bromide.

MORPHINÆ CITRATIS.—Each fluidrachm (4 Cc.) contains 2 grains (0.12 Gm.) of Morphine in the form of citrate.

MORPHINÆ HYPODERMICUS (Magendie's Solution of Morphine).[1]—16 grains (1 Gm.) Morphine Sulphate to 1 fluidounce (30 Cc.).

PANCREATICUS (Pancreatic Solution).—Each fluidrachm (4 Cc.) represents 1 grain (0.06 Gm.) of Pancreatin, effectually preserved in Glycerin and a little Alcohol.

PEPSINI AROMATICUS.—Each fluidrachm (4 Cc.) represents 1 grain (0.06 Gm.) of Pepsin.

PHOSPHORI (Thompson's Solution of Phosphorus).—Each fluidrachm (4 Cc.) contains about $\frac{1}{24}$ grain (0.0025 Gm.) of Phosphorus, preserved in Absolute Alcohol and Glycerin.

PICIS ALKALINUS (Tar, Alkaline).

POTASSÆ CHLORATÆ (Solution of Chlorinated Potassa; Javelle Water).—An effective and popular disinfectant.

POTASSII ARSENATIS ET BROMIDI (Liquor Arsenii Bromidi; Clemens' Solution).—This solution contains an amount of Arsenic in combination corresponding to about 1 per cent. of Arsenic Trioxide.

The title "Solution of Bromide of Arsenic" (Liquor Arsenii Bromidi), which is often applied to Clemens' Solution or similar preparation, is a misnomer, since bromide of arsenic cannot exist, as such, in presence of water, but is split up into hydrobromic and arsenous acids. The proportions of the ingredients, in the formula above given, have been adjusted as closely as practicable, so as to yield definite compounds—viz. arsenate and bromide of potassium.

[1] Particular care should be taken in prescribing and dispensing this solution, so that it may not be mistaken for the so-called United States Solution of Morphine (Liquor Morphiæ Sulphatis, U. S. P. 1870), containing only 1 grain of Sulphate of Morphine in each fluidounce, which is still occasionally used.

Liquor—

SACCHARINI (Solution of Saccharin).—Each fluidram represents 4 grains of Saccharin.

Intended to be used for sweetening liquids and solids when the use of sugar is objectionable, or when a sweet taste is to be imparted to a liquid without increasing its density.

SERIPARUS (Liquid Rennet).

If this liquid is to be used merely for curdling milk, without separating the whey as a distinct layer, it should be added to the milk, previously warmed to a temperature of about 35° C. (95° F.), and the mixture should then be set aside undisturbed until it coagulates. If the whey is to be separated, the Liquid Rennet should be added to the milk while cold, and the mixture heated to about 35° C. (95° F.), but not exceeding 40° C. (104° F.). One part of the liquid should coagulate between 200 and 300 parts of cows' milk.

LIQUOR SODII ARSENATIS, PEARSON.—This Solution contains about $\frac{1}{10}$ per cent. of anhydrous Sodium Arsenate.

This preparation should not be confounded with the Liquor Sodii Arsenatis of the U. S. P., which is ten times stronger than the above. Pearson's Solution is official in the French Pharmacopœia, under the title Solute d'Arseniate de Soude (or Solution Arsenicale de Pearson).

SODII BORATIS COMPOSITUS (Dobell's Solution).—Sodium Borate and Sodium Bicarbonate, each 120 grains (8.0 Gm.); Phenol, 24 grains (1.5 Gm.); Glycerin, $\frac{1}{2}$ fluidounce (15 Cc.); in Water, 16 fluidounces (450 Cc.).

SODII CARBOLATIS (Phénol Sodique).—Phenol, 50 per cent.; Sodium Hydroxide, 3 per cent.; in Water.

SODII CITRATIS.—Saturatio (Potio Riveri, Ph. Ger.).—Citric Acid, 150 grains (10.0 Gm.); Sodium Bicarbonate, 190 grains (12.5 Gm.); in Water, 16 fluidounces (450 Cc.).

SODII CITRO-TARTRATIS (Effervescing Saline Water).—Sodium Bicarbonate, Tartaric Acid, Citric Acid, Syrup, and Water, in about the same proportions as in Solution of Magnesium Citrate, for which it is a cheaper substitute.

SODII OLEATIS (Oleate of Sodium).—Intended to be used in the preparation of oleates.

STRYCHNINÆ ACETATIS (Hall's Solution of Strychnine).—Each fluidrachm (4 Cc.) contains $\frac{1}{8}$ grain (0.008 Gm.) Strychnine Acetate.

The Ph. Br. directs a Liquor Strychninæ Hydrochloratis (with synonym, Liquor Strychniæ) which is much stronger, and should not be confounded with the above preparation. It should never be dispensed unless expressly designated.

Liquor—

ZINCI ET FERRI COMPOSITUS (Deodorant Solution).—A combination of Sulphates of Zinc and Iron, Naphthol, Oil of Thyme, and Hypophosphorous Acid, in Water.

Used as a simple deodorant and antiseptic for common domestic use when it is unnecessary or impracticable to employ more powerful agents.

When a deodorant solution is required for purposes where iron is objectionable—as, for instance, when woven fabrics are to be steeped in it—the following preparation may be employed:

Liquor Zinci et Aluminii Compositus, in which the Iron Sulphate is replaced by Aluminum Sulphate.

ZINGIBERIS (Essence of Ginger).—A 25 per cent. preparation of Ginger for flavoring aqueous mixtures.

SPIRITUS—SPIRITS.

The Spirits are solutions of volatile substances in Alcohol. They comprise (1) the Distilled Spirits; (2) the Aromatic Spirits, or so-called "Essences"; and (3) the Medicinal Spirits.

The *Distilled Spirits* are:

Spiritus Frumenti (Whiskey), containing Alcohol 44–55 per cent. by volume.

Spiritus Vini Gallici (Brandy), containing Alcohol 46–55 per cent. by volume.

The *Aromatic Spirits* are made by dissolving the respective oils or aromatic principles in Alcohol:

Spiritus—		*Cc. in 100 Cc., or percentage by vol.*
Amygdalæ Amaræ (water 19)	bitter almond oil	1.
Anisi	anise oil	10.
Aurantii Comp.	oil of orange peel	20.
	oils, anise 0.5; coriander 2; lemon	5.
Camphoræ	camphor	10.
Cinnamomi	cinnamon oil	10.
Gaultheriæ	wintergreen oil	5.
Juniperi	juniper oil	5.
Juniperi Compositus	oil of juniper 0.4; oil of caraway 0.05; oil of fennel 0.05; alcohol 70; water to make	100.
Lavandulæ	lavender oil	5.
Menthæ Piperitæ	peppermint herb 1; oil	10.
Menthæ Viridis	spearmint herb 1; oil	10.

These are chiefly used for flavoring purposes; some are used

medicinally as aromatic stimulants and carminatives in doses of from 15–30 minims (1–2 Cc.); Spiritus Amygdalæ Amaræ contains Hydrocyanic Acid, and is never used internally except in very small quantities as a flavor.

The *Medicinal Spirits* are made by solutions of the medicinal substance in Alcohol.

The following are official:

Spiritus—		Cc. in 100 C.c., or percentage by vol.
Ætheris	ether $(C_2H_5)_2O$	32.5
Ætheris Comp. (Hoffmann's Anodyne)	ethereal oil	2.5
	ether	32.5
Chloroformi	chloroform	6.
		By weight.
Ætheris Nitrosi (Sweet Spirit of Nitre)	ethyl nitrite	4.
Ammoniæ	ammonia gas	10.
Ammoniæ Aromaticus	water 20; ammonia water	9.
	ammonia carb.	3.4
	oils, lavender, nutmeg, each 0.1; lemon oil	1.
Glycerylis Nitratis	nitroglycerin	1.

The *dose* of these Spirits is from 30 to 60 minims (2 to 4 Cc.; about 75 to 150 "drops"), except the Ammonia Spirit, used only in the preparation of Liniments (externally), and that of Glyceryl Nitrate, of which the dose is 1 minim (0.06 Cc.).

Unofficial Spirits of the National Formulary.

Spiritus—

Acidi Formici (Spirit of Ants, Ph. Ger.).—A solution of 3 per cent. of Formic Acid in Water and Alcohol.

Ophthalmicus (Alcoholic Eye-wash).—A solution of 10 minims (0.6 Cc.) Oil of Lavender and 30 minims (2 Cc.) Oil of Rosemary, in Alcohol 1 fluidounce (30 Cc.).

Saponatus (Spirit of Soap).

Sinapis (Spirit of Mustard, Ph. Ger.).—A solution of 2½ per cent. of Volatile Oil of Mustard in Alcohol.

SYRUPI—SYRUPS.

Syrups are nearly *saturated* Solutions of Sugar in Water, in which aromatic or medicinal substances are dissolved.

Syrups should be kept in a *cool* place, in cork-stoppered bottles, in order to *preserve* them.

The official Syrup, *Syrupus*, contains 85 grams of sugar in

100 Cc.: with a smaller proportion of Sugar the syrup may undergo fermentation (spoil).

The official Syrups are made by different methods: by solution, or mixing the medicinal substances with the syrup; by dissolving the Sugar in the medicinal solution; by extraction from the drug; and by chemical reaction and solution.

They may be divided into (1) the aromatic or adjuvant syrups, and (2) the medicinal syrups, comprising (*a*) those made from extractive drugs, and (*b*) those made from chemicals, either by simple solution or by chemical reaction and solution.

The *Aromatic* or *Adjuvant Syrups* are mostly used to improve the taste of salty, bitter, or otherwise unpleasant mixtures.

The following are official:

Syrupus—		*Cc. in 100 Cc., or percentage by vol.*
Acaciæ	acacia	10.
Acidi Citrici	tincture of fresh lemon peel	1.
	acid, citric	1.
Amygdalæ	spirit of bitter almond	1.
	orange flower water	10.
Aurantii	tincture of sweet orange peel 5; citric acid	0.5
Aurantii Florum	sugar	85.
	orange flower water to make	100.
Tolutanus	tincture of tolu	5.
Zingiberis	fluidextract of ginger	3.

The *Extractive Syrups* are often made by mixing the Fluidextract of the respective drugs with Syrup.

Tinctures and Fluidextracts of *resinous* drugs often precipitate when mixed with Syrups and aqueous solutions. In order to furnish clear mixtures it is therefore sometimes necessary to mix the extractive preparation with Water, clarify the mixture by filtration, and dissolve the sugar in the filtered liquid.

The following are official:

Syrupus—		*Gm. of Drug in 100 Cc.*
Ipecacuanhæ	acetic acid 1; fluidext. ipecac	7.
Krameriæ	fluidext. rhatany	45.
Lactucarii	tinct. lactucarium	10.
Picis Liquidæ	tar	5.
Pruni Virginianæ	wild cherry	15.
	spirit of cinnamon 0.4, potass. carb.	1.
Rhei	fluidext. rhubarb	10.

Syrupus—		Gm. of Drug in 100 Cc.
Rhei Aromaticus	tinct. rhubarb, arom.	15.
Rosæ	fluidext. rose	12.5
Rubi	fluidext. rubus	25.
Sarsaparillæ Comp.	fl. ext. sarsaparilla	20.
	fl. ext. glycyrrh., senna, each	1.5
	oils, sassafras, anise, gaultheria, each	0.01
Scillæ	vinegar of squill	45.
Scillæ Comp.	fl. exts. squill, senega, each	8.
(Coxe's Hive Syrup)	antimony and potass. tart.	0.2
Senegæ	fl. ext. senega	20.
Sennæ	oil coriander 0.5; senna	25.

The *Chemical Syrups* are an elegant class of preparations in which the taste of the medicinal agents is greatly modified. They do not keep well unless put up in small bottles completely filled, ready for dispensing. Except the Syrup of Iodide of Iron, which is best preserved in bottles exposed to light, they should be kept in a *cool* and *dark* place.

The following are official:

Syrupus—		Percentage, Gm. or Cc. in 100.
Acidi Hydriodici	acid, hydriodic, by weight	1.
Calcii Lactophosphatis	calcium carbonate 2.5;	
	lactic acid 6; phosphoric acid	3.6
Calcis	lime	6.5
Ferri Iodidi	ferrous iodide, by weight	5.

	Grains in 1 fluid-dram (4 Cc.).	Percentage by vol.
Ferri, Quininæ et Strychninæ Phosphatum: glycerite of the phosphates of iron, quinine, and strychnine		25.
Hypophosphitum . . . calcium hypophosphite	3	4.5
potassium and sodium hypophosphites, each	1	1.5
tincture of fresh lemon peel 0.5; acid hypophos. dil.		0.2
Hypophosphitum Comp. . calcium hypophosphite 3.5; potassium and sodium hypophosphites, each 1.75; ferric and manganese hypophosphites, each 0.225; sodium citrate 0.375; quinine 0.11; strychnine 0.0115; diluted hypophosphorous acid 1.5.		

Unofficial Syrups of the National Formulary.

Unless otherwise stated, the *dose* is 1 to 2 fluidrachms or teaspoonfuls (4–8 Cc.).

Syrupus—

ACTÆÆ COMPOSITUS (Cimicifuga or Black Cohosh).—Containing 2½ grains (0.15) each of Cimicifuga and Wild Cherry, 1¼ grains (0.07) Glycyrrhiza and Senega, and ⅝ grain (0.04) Ipecac in each fluidrachm (4 Cc.).

ASARI COMPOSITUS (Canada Snake Root).—Each fluidrachm (4 Cc.) represents 3½ grains (0.2) of Asarum.

CALCII CHLORHYDROPHOSPHATIS (Chlorhydrophosphate of Lime).—Each fluidrachm (4 Cc.) contains 1 grain (0.06) of Calcium Phosphate.

CALCII ET SODII HYPOPHOSPHITUM (Hypophosphite of Lime and Soda).—Each fluidrachm (4 Cc.) contains 2 grains (0.13), each, of Hypophosphites of Calcium and Sodium.

CALCII HYPOPHOSPHITIS (Hypophosphite of Lime).—Each fluidrachm (4 Cc.) contains 2 grains (0.13) of Calcium Hypophosphite.

CALCII IODIDI (Iodide of Calcium).—Each fluidrachm (4 Cc.) contains about 5 grains (0.3) of Calcium Iodide.

CALCII LACTOPHOSPHATIS CUM FERRO (Lactophosphate of Lime with Iron).—Each fluidrachm (4 Cc.) contains ½ grain (0.03) of Lactate of Iron and about ¼ grain (0.015) of Calcium Lactate (or about ⅜ grain (0.02) of so-called Lactophosphate of Calcium).

CHONDRI COMPOSITUS (Irish Moss).—Containing 1 grain (0.06) each of Squill and Senega, $\frac{1}{16}$ grain (0.004) each of Ipecac and Irish Moss, and 1⅜ minims (0.1) Tincture Opium Camph. to each fluidrachm (4 Cc.).

CINNAMOMI (Cinnamon, Ph. Ger.).—Chiefly used for flavoring.

CODEINÆ.—Containing ½ grain (0.03) Codeine Sulphate in each fluidrachm (4 Cc.). The Syrup of the French Codex is about one-fourth this strength.

COFFEÆ (Coffee).—Containing 15 grains (1.) of the choicest Coffee (Java and Mocha) in fluidrachm (4 Cc.); an elegant vehicle for Quinine and addition to nauseous mixtures.

ERIODICTYI AROMATICUS (Yerba Santa; Syrupus Corrigens).—Chiefly intended as a vehicle for disguising the taste of Quinine and other bitter substances.

FERRI ARSENATIS.—Each fluidrachm (4 Cc.) contains about $\frac{1}{60}$ grain (0.001) of Arsenate of Iron (ferric).

Syrupus—

FERRI BROMIDI (U. S. P., 1880).—Containing 10 per cent. of Ferrous Bromide.

FERRI CITRO-IODIDI (Tasteless Syrup of Iodide of Iron).—Each fluidrachm (4 Cc.) contains an amount of Iron corresponding to about 3.6 grains (0.25) of Ferric Iodide. The official Syrupus Ferri Iodidi contains about 8 grains (0.5) of Ferrous Iodide (Protiodide of Iron) in each fluidrachm (4 Cc.).

FERRI ET MANGANI IODIDI (Iodide of Iron and Manganese).—Each fluidrachm (4 Cc.) contains 6 grains (0.4) of Iodide of Iron (ferrous) and 3 grains (0.2) of Iodide of Manganese.

FERRI HYPOPHOSPHITIS (Hypophosphite of Iron).—Each fluid-drachm (4 Cc.) contains 1 grain (0.06) of Hypophosphite of Iron (ferric).

FERRI LACTOPHOSPHATIS (Lactophosphate of Iron).—Each fluidrachm (4 Cc.) contains 1 grain (0.06) of Lactate of Iron, or about 1½ grains (0.1) of so-called Lactophosphate of Iron.

FERRI PROTOCHLORIDI (Ferrous Chloride).—Each fluidrachm (4 Cc.) contains about 1 grain (0.06) of Protochloride of Iron.

FERRI SACCHARATI SOLUBILIS (Soluble Saccharated Iron; Saccharated Oxide of Iron, Ph. Ger.).—Each 75 minims (5 Cc.) represents approximately 1 grain (0.06) of Metallic Iron, or 3 grains (0.2) of Oxide of Iron.

GLYCYRRHIZÆ (Liquorice).—Each fluidrachm (4 Cc.) represents 30 grains (2.) of Glycyrrhiza.

HYPOPHOSPHITUM COMPOSITUS.—Each fluidrachm (4 Cc.) contains 2 grains (0.12) of Calcium Hypophosphite, 1 grain (0.06), each, of the Hypophosphites of Potassium and Sodium, ⅛ grain (0.008), each, of the Hypophosphites of Iron and Manganese, $\frac{1}{16}$ grain (0.004) of Quinine Hydrochlorate, and 1¼ minims (0.01) of Tincture of Nux Vomica.

This Syrup should not be confounded with the official Syrupus Hypophosphitum (Syrup of the Hypophosphites: Calcium, Sodium, and Potassium). It is intended to replace a well-known proprietary article, for which it has been found by many physicians to be a satisfactory substitute. It is uniform in composition and more stable and elegant than the patent article.

IPECACUANHÆ ET OPII (Syrup of Dover's Powder).—Each fluidrachm (4 Cc.) represents 5 grains (0.3) of Dover's Powder, or ½ grain (0.03), each, of Ipecac and Opium.

Syrupus—

MANNÆ (Syrup of Manna, Ph. Ger.).

MORPHINÆ COMPOSITUS.—A preparation sometimes dispensed as Jackson's Pectoral Syrup, but, as it differs in essential particulars, the N. F. recommends that this preparation be dispensed only when expressly designated under this title. Each fluidrachm (4 Cc.) contains $\frac{1}{8}$ grain (0.008) Ipecac, 5 grains (0.3) Senega, 1 grain (0.06) Rhubarb, and $\frac{1}{32}$ grain (0.002) Morphine, with Oil of Sassafras.

MORPHINÆ SULPHATIS (Syrup of Morphine).—Each fluidrachm (4 Cc.) contains $\frac{1}{8}$ grain (0.008) of Sulphate of Morphine.

PAPAVERIS (Poppy, Ph. Br.; Diacodii, Ph. Ger.).—Similar to the preceding, but considerably weaker.

PECTORALIS (Jackson's Pectoral Syrup).—Each fluidrachm (4 Cc.) contains $\frac{1}{32}$ grain (0.002), each, of Morphine and Oil of Sassafras.

PHOSPHATUM COMPOSITUS (Chemical Food).—Each fluidrachm (4 Cc.) contains about 2 grains (0.12) of Phosphate of Calcium, 1 grain (0.06), each, of the Phosphates of Iron and Ammonium, and smaller quantities of the Phosphates of Potassium and Sodium.

PINI STROBI COMPOSITUS (White Pine Compound).—A combination of White Pine, Wild Cherry, Spikenard, Sanguinaria, Chloroform, and Morphine, $\frac{1}{32}$ grain (0.002) in a fluidrachm.

RHAMNI CATHARTICÆ (Buckthorn Berries; Syrupus Spinæ Cervinæ, Ph. Ger.).

RUBI AROMATICUS (Blackberry, Aromatic).—A combination of Rubus, Cinnamon, Nutmeg, Cloves, and Allspice.

SANGUINARIÆ (Bloodroot).—Each fluidrachm (4 Cc.) represents 13 grains (0.8) of Sanguinaria.

SENNÆ AROMATICUS (Senna, Aromatic).—Each fluidrachm (4 Cc.) represents $7\frac{1}{2}$ grains (0.5) of Senna, 3 grains (0.2) of Jalap, and 1 grain (0.06) of Rhubarb, with aromatics.

SENNÆ COMPOSITUS (Senna, Compound).—Each fluidrachm (4 Cc.) represents 8 grains (0.5) of Senna, 2 grains (0.12), each, of Rhubarb and Frangula.

SODII HYPOPHOSPHITIS.—Each fluidrachm (4 Cc.) contains 2 grains (0.12) of Sodium Hypophosphite.

STILLINGIÆ COMPOSITUS.—Each fluidrachm (4 Cc.) represents 15 minims (1 Cc.) of Compound Fluid Extract of Stillingia.

Syrupus—

OXYMEL SCILLÆ (Oxymel of Squill, Ph. Br.).—A preparation of Honey containing about 5 grains (.32 Gm.) of Squill in each fluidrachm (4 Cc.).

ELIXIRIA—ELIXIRS.

Elixirs are a class of elegant preparations similar to wines or cordials, composed of Water, Sugar, Alcohol, and Aromatics.

The medicinal substances are usually in such proportion that an ordinary dose may be contained in one or two teaspoonfuls (4 to 8 Cc.) of the elixir. The official Elixirs are:

Elixir Adjuvans:
fluidextract of glycyrrhiza 12; aromatic elixir 88.

Elixir Aromaticum:
compound spirit of orange 1.2; syrup 37.5; alcohol 25.

Elixir Ferri, Quininæ et Strychninæ Phosphatum:
soluble ferric phosphate 1.75; quinine 0.875; strychnine 0.0275; phosphoric acid 0.2 [each fluidram contains 1 grain (0.06 Gm.) of ferric phosphate, and $\frac{1}{2}$ grain (0.03 Gm.) quinine, and $\frac{1}{64}$ grain (0.001 Gm.) strychnine in the form of phosphate].

Elixirs of the National Formulary.

The value of pleasant vehicles to mask or modify the taste of bitter and nauseous drugs is recognized by every prescriber. The following Elixirs of the National Formulary have been carefully selected, and embrace the most effective combinations of adjuvants and aromatics for disguising the different drugs for which they are recommended:

Elixir—

ANISI; a combination of Anethol, Fennel, and Bitter Almond.

CURASSAO (Curaçao Cordial); a combination of Curaçao, Orris, and a little Citric Acid.

Adjuvant Elixirs.—The following are intended as vehicles for Quinine and similar bitter substances, and as adjuvants for Tinctures and Fluid Extracts of bitter and resinous drugs, such as Cinchona, Cascara Sagrada, etc. They all contain Glycyrrhiza, which, in the form directed in the N. F. (Russian Licorice Root, peeled), is most effective in masking the bitter taste of Quinine, when it is directed to be simply suspended in the mixture without the use of acid for effecting solution. Acids precipitate the glycyrrhizin and destroy its power of masking the bitter taste:

Elixir—

ADJUVANS; a combination of Orange, Wild Cherry, Glycyrrhiza, Coriander, and Caraway.

Except for the exhibition of Quinine this is the most effective of the adjuvant Elixirs.

ERIODICTYI AROMATICUM (Arom. Elixir Yerba Santa; Elixir Corrigens).—A solution of Yerba Santa in Comp. Elixir of Taraxacum, intended as a vehicle for Quinine and other bitter remedies.

GLYCYRRHIZÆ (Elixir of Licorice); a solution of Licorice in Aromatic Elixir, the most effective vehicle for Quinine.

GLYCYRRHIZÆ AROMATICUM; Elixir of Licorice, with the addition of strong aromatics.

TARAXACI COMPOSITUM; an improved form of this well-known compound, useful as a mild adjuvant.

Medicinal Elixirs.—These comprise the Elixirs mostly in use; also, a number of preparations in which the prescriber will find satisfactory substitutes, designated by scientific titles and of definite strength and uniform composition, intended to replace various nostrums.

Elixir—	Active Drug in 1 Fluidrachm. grains.	4 Cc. Gm.
ACIDI SALICYLICI	5	0.3
AMMONII BROMIDI	5	0.3
AMMONII VALERIANATIS	2	0.12
The odor and taste of the salt being well covered by the addition of vanilla and a little chloroform.		
AMMONII VALERIANATIS ET QUININÆ.—The above, with Quinine Hydrochlorate	¼	0.015
APII GRAVEOLENTIS (Celery Compound).—Containing Celery, Coca, Kola, and Viburnum, each	4	0.25
BISMUTHI.—Bismuth and Ammonium Citrate	2	0.12
BUCHU	7½	0.5
BUCHU COMPOSITUM.—Buchu, Cubeb, Juniper, and Uva Ursi, combined	15	1.
BUCHU ET POTASSII ACETATIS.—Elixir Buchu, with Potassium Acetate	5	0.3
CAFFEINÆ.—Caffeine (in solution in Hydrobromic Acid)	1	0.06
CALCII BROMIDI	5	0.3

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Elixir—	Active Drug in 1 Fluidrachm. Grains.	Active Drug in 4 Cc. Gm.
CALCII HYPOPHOSPHITIS	2	0.12
CALCII LACTOPHOSPHATIS.—Calcium Lactate (in Phosphoric Acid)	1	0.06
CATHARTICUM COMPOSITUM.—Each fluidrachm (4 Cc.) contains Senna 7½ grains (0.5); Podophyllum 4 grains (0.25); Leptandra and Jalap, each 3 grains (0.2); Rochelle Salts 7½ grains (0.5); and Sodium Bicarbonate 1 grain (0.06). The mixture should be shaken.		
CHLOROFORMI COMPOSITUM.—A mixture of equal parts of Chloroform, Tincture of Opium, Spirit of Camphor, Aromatic Spirit of Ammonia, and Alcohol, flavored with Cinnamon. The old title, "Chloroform Paregoric," is recommended to be abandoned for the above. Each fluidrachm (4 Cc.) contains 1 grain (0.06) of Opium and 11 minims (0.7) of Chloroform.		
CINCHONÆ (Elixir Calisaya).—This preparation is from the best Calisaya Bark, representing about 2 grains (0.12) in each fluidrachm (4 Cc.). It is preferable to preparations made from Quinine and the cheaper alkaloids in being a more agreeable and effective antiperiodic tonic.		
CINCHONÆ ET FERRI (Calisaya and Iron; Ferrated Elixir of Calisaya).—Phosphate of Iron	2	0.12
CINCHONÆ ET HYPOPHOSPHITUM.—Calcium and Sodium Hypophosphites, each	1	0.06
CINCHONÆ, FERRI, BISMUTHI ET STRYCHNINÆ. —Phosphate of Iron	2	0.12
Bismuth and Ammonium Citrate	1	0.06
Strychnine Sulphate	$\frac{1}{100}$	0.0007
CINCHONÆ, FERRI ET BISMUTHI.—Phosphate of Iron	2	0.12
Bismuth and Ammonium Citrate	1	0.06
CINCHONÆ, FERRI ET CALCII LACTOPHOSPHATIS. —Phosphate of Iron	1½	0.1
Calcium Lactophosphate . . . about	1	0.06

Elixir—	Active Drug in 1 Fluidrachm. Grains.	4 Cc. Gm.
CINCHONÆ, FERRI ET PEPSINI.—Phosphate of Iron	1½	0.1
Pepsin	1	0.06
CINCHONÆ, FERRI ET STRYCHNINÆ.—Phosphate of Iron	2	0.12
Sulphate of Strychnine	1/100	0.0007
CINCHONÆ, PEPSINI ET STRYCHNINÆ.—Containing smaller quantities of the Cinchona Alkaloids, Pepsin 1 grain (0.06), and Sulphate of Strychnine	1/100	0.0007
COCÆ (Coca).—Leaves, Erythroxylon Coca	7½	0.5
COCÆ ET GUARANÆ.—Coca and Guarana, of each	7½	0.5
CORYDALIS COMPOSITUM.—Containing of Corydalis, Stillingia, Iris, and Xanthoxylum, combined	15	1.
Potassium Iodide	3	0.2
DIGESTIVUM COMPOSITUM.—Containing about 5 grains (0.3) of Pulvis Digestivus in each fluidrachm (4 Cc.).		
EUCALYPTI.—Eucalyptus Globulus	7½	0.5
EUONYMI (Wahoo).—Euonymus Atropurpureus	10	0.6
FERRI HYPOPHOSPHITIS.—Hypophosphite of Iron (ferric)	1	00.6
FERRI LACTATIS	1	0.06
FERRI PHOSPHATIS.—Phosphate of Iron (U.S.P.)	2	0.12
FERRI PHOSPHATIS, CINCHONIDINÆ ET STRYCHNINÆ.—Phosphate of Iron	2	0.12
Cinchonidine	½	0.03
Sulphate of Strychnine	1/100	0.0007
FERRI PHOSPHATIS, QUININÆ ET STRYCHNINÆ.—Phosphate of Iron, 1 grain (0.06); Quinine	½	0.03
Sulphate of Strychnine	1/64	0.001
FERRI PYROPHOSPHATIS	2	0.12
FERRI, QUININÆ ET STRYCHNINÆ.—Ferric Chloride, 1 grain (0.06); Quinine Hydrochlorate	½	0.03
Sulphate of Strychnine	1/100	0.0007
FRANGULÆ (Buckthorn).—Rhamnus Frangula	15	1.

Elixir—	Active Drug in 1 Fluidrachm. Grains.	4 Cc. Gm.
GENTIANÆ	2	0.12
GENTIANÆ CUM TINCTURA FERRI CHLORIDI.—Tincture Citro-chloride of Iron	5	0.3
GENTIANÆ ET FERRI PHOSPHATIS (ferrophosphated).—Phosphate of Iron	1	0.06
GRINDELIÆ.—Grindelia Robusta	4	0.25
GUARANÆ.—Paullinia Cupana	12	0.75
HUMULI	7½	0.5
HYPOPHOSPHITUM.—Calcium Hypophosphite	3	0.2
Sodium and Potassium Hypophosphites, each	1	0.06
HYPOPHOSPHITUM CUM FERRO.—Calcium and Sodium Hypophosphite, each	1	0.06
Potassium and Iron Hypophosphites, each	½	0.03
LITHII BROMIDI	5	0.3
LITHII CITRATIS	5	0.3
LITHII SALICYLATIS	5	0.3
MALTI ET FERRI.—Phosphate of Iron	1	0.06
Malt Extract	15	1.
PARALDEHYDI.—Paraldehyde	15	1.
PEPSINI.—Pepsin	1	0.06
PEPSINI, BISMUTHI ET STRYCHNINÆ.—Elixir Pepsin and Bismuth, and Strychnine	$\frac{1}{100}$	0.0007
PEPSINI ET BISMUTHI.—Pepsin	1	0.06
Bismuth and Ammonium Citrate	2	0.12
PEPSINI ET FERRI.—Elixir of Pepsin and Tincture Citro-chloride of Iron	5.	0.3
PHOSPHORI ET NUCIS VOMICÆ.—Elixir Phosphorus, with Tincture Nux Vomica	2	0.12
PICIS COMPOSITUM.—A combination of Prunus Virginiana, Tolu, Methylic Alcohol, and Sulphate of Morphine	$\frac{1}{40}$	0.0015
PILOCARPI (Jaborandi).—Pilocarpus Selloanus	4	0.25
POTASSII ACETATIS	5	0.3
POTASSII ACETATIS ET JUNIPERI.—Elixir Potass. Acet. with Juniper	7½	0.5
POTASSII BROMIDI.—Potassium Bromide, effectually masked in Adjuvant Elixir	10	0.6
An Elixir half this strength has also been used.		

Elixir—	*Active Drug in* 1 *Fluidrachm. Grains.*	*Active Drug in* 4 *Cc. Gm.*
Quininæ Compositum (Red).—Sulphates of Quinine, 1/8 grain (0.008), Cinchonidine and Cinchonine, each	1/16	0.004
Chiefly intended as a substitue for Elixir Cinchona when the administration of other constituents of the bark may be deemed objectionable.		
Quininæ et Phosphatum Compositum.—Quinine Sulphate	1/4	0.015
Phosphate of Iron	1	0.06
Calcium Lactophosphate	3/4	0.05
Quininæ Valerianatis et Strychninæ.—Valerianate of Quinine	1	0.06
Sulphate of Strychnine	1/100	0.0007
Rhamni Purshianæ (Cascara Sagrada).—Rhamnus Purshiana, its bitterness effectually masked with Elixirs of Glycyrrhiza and Taraxacum Compound	15	1.
Rhamni Purshianæ Compositum (Laxative Elixir; Elixir Purgans).—Cascara Sagrada	7½	0.5
Senna and Juglans, each	5	0.3
Associated with aromatics and correctives; a most effective laxative in doses of from 1 to 2 fluidrachms (4–8 Cc.).		
Rhei.—Sweet Tincture of Rhubarb, representing Rhubarb	2¼	0.15
Rhei et Magnesiæ Acetatis.—Magnesium Acetate, 4 grains (0.25); Rhubarb	7½	0.5
Rubi Compositum (Blackberry Compound).—Blackberry Root, Galls, and Cinnamon (Saigon), in equal proportions, combined with smaller quantities of Cloves, Mace, and Ginger, in Blackberry Juice and Syrup.	10	0.6
Sodii Bromidi.—Sodium Bromide, in Adjuvant Elixir	10	0.6
Sodii Hypophosphitum	2	0.12
Sodii Salicylatis (to be freshly prepared when required for use)	5	0.3

Elixir—	Active Drug in 1 Fluidrachm. Grains.	Active Drug in 4 Cc. Gm.
STILLINGIÆ COMPOSITUM.—Compound Fluid Extract of Stillingia, N. F.	15	1.
STRYCHNINÆ VALERIANATIS	$\frac{1}{100}$	0.0007
TURNERÆ (Damiana).—Turnera Aphrodisiaca	10	0.6
VIBURNI OPULI COMPOSITUM.—Viburnum Opulus, Aletris Farinosa, each	5	0.3
Trillium (Beth Root)	10	0.6
VIBURNI PRUNIFOLII (Black Haw)	$7\frac{1}{2}$	0.5
ZINCI VALERIANATIS.—Zinc Valerianate	1	0.06

CORDIALE RUBI FRUCTUS (Blackberry Cordial).—An aromatic Syrup of Blackberry Juice, used as a mild astringent in bowel complaints.

SUCCUS LIMONIS CUM PEPSINO (Lime Juice and Pepsin).—Each fluidrachm (4 Cc.) represents 2 grains (0.12) of Pepsin.

GLYCERITA—GLYCERITES.

The Glycerites, or "Glyceroles," are solutions of substances in Glycerin.

They are made either by direct solution, by heat, or by extraction of a drug, as in Hydrastis; one is made by chemical reaction —*i. e.* Boroglycerin.

Glyceritum—		*Percentage by weight.*
Acidi Tannici	acid, tannic	20.
Amyli	water 10; starch	10.
Boroglycerini	(boric acid 31. or) boroglyceride	50.
Glyceritum Ferri, Quininæ et Strychninæ Phosphatum soluble ferric phosphate 8, quinine 10.4, strychnine 0.08, phosphoric acid 20 [1 Cc. contains 0.104 Gm. ($1\frac{5}{8}$ gr.) quinine, and 0.0008 Gm. ($\frac{1}{80}$ gr.) strychnine].		
Hydrastis	representing hydrastis	100.
Phenolis	liquefied phenol	20.

The Glycerite of Starch is used chiefly as an excipient for Pill-masses.

Unofficial Glycerites of the National Formulary.

Glyceritum—

PEPSINI (Glycerole of Pepsin).—Each 4 Cc. (fluidrachm) represents 0.3 (5 grains) of Pepsin.

PICIS LIQUIDÆ (Tar).—Containing about 0.3 (5 grains) of Tar.

TRAGACANTHÆ.—Containing about 12 per cent. of tragacanth.

MUCILAGINES—MUCILAGES.

The Mucilages are prepared by extracting a mucilaginous drug with Water or dissolving a Gum in Water.

The following four are official:

Mucilago—		*Gm. in 100 Cc., or percentage.*
Acaciæ	lime water 33; acacia	34.
Sassafras Medullæ	sassafras pith	2.
Tragacanthæ	glycerin 18; tragacanth	6.
Ulmi	slippery-elm bark	6.

The Mucilages are chiefly employed as vehicles in Mixtures to aid in suspending insoluble substances; as excipients in Pills and Troches; and as emulsifying agents. They are sometimes used for their demulcent effect.

THE LIQUID MIXTURES—INTERNAL.

MISTURÆ—MIXTURES.

The official Mixtures are liquid preparations, for internal use, of medicinal substances suspended in Water containing *sugar*, *gum*, or *glycerin*. They require to be shaken up before using. They should be prepared extemporaneously. The term Mixture is also applied to any combination of substances that cannot be otherwise classified.

There are four official mixtures:

Mistura—		*Gms. in 100 Cc.*
Cretæ (Chalk Mixture)	comp. chalk powder	20.
	cinnamon water 40; water, to	100.
Ferri Comp. (Griffith's Mixt.)	myrrh, sugar, each	1.8
	potass. carb.	0.8
	triturate with gradual addition of rose water	70.
	ferrous sulphate, 0.6; spir. lavend., 6; rose water, to	100.
Glycyrrhizæ Comp.	pure extract glycyrrhiza	3.0
(Brown Mixture)	Spirit nitrous ether	3.
	wine antimony	6.
	tinct. opium. camph.	12.
	syrup 5; acacia 3; water, to	100.
Rhei et Sodæ	sodium bicarbonate	3.5
	fl. exts. ipecac 0.3, rhubarb	1.5
	spirit peppermint 3.5; glycerin 35.; water, to	100.

Unofficial Mixtures of the National Formulary.

Mistura—

ACACIÆ—(Mistura Gummosa, Ph. Ger.).—Acacia, pulv., Sugar, in Water.

Should be freshly made when wanted for use.

ADSTRINGENS ET ESCHAROTICA (Villate's Solution).—Solution of Lead Subacet. 1½ fluidounces (45.); Sulphates of Copper, Zinc, each, 1 troy ounce (30.); Acetic Acid 13 fluidounces (360 Cc.).

AMMONII CHLORIDI (Mistura Solvens Simplex).—Ammonium Chloride, Purif. Ext. Glycyrrhiza, each 180 grains (12.), in Water 16 fluidounces (450 Cc.).

Mistura (or *Mixtura*) *Solvens Stibiata* is prepared by dissolving 0.3 Antimony and Potassium Tartrate in 1000 Cc. of Mistura Ammonii Chloridi.

CAMPHORÆ ACIDA (Mistura Antidysenterica; Hope's Mixture).—Nitric Acid 120 mins. (8 Cc.); Tinct. Opium 80 mins. (5 Cc.); in Camphor Water 16 fluidounces (450 Cc.).

CAMPHORÆ AROMATICA (Parrish's Camphor Mixture).—Tinct. Lavender Comp. 4 fluidounces (120 Cc.); Sugar 240 grains (15.); in Camphor Water 16 fluidounces (450 Cc.).

CARMINATIVA (Dalby's Carminative).—Magnes. Carb. 1 troy ounce (30.); Potass. Carb. 20 grains (1.3); Tinct. Opium 180 mins. (12 Cc.); Oils of Caraway, Fennel, Peppermint, each, 4 drops (0.1); Syrup 2½ fluidounces (75 Cc.); in 16 fluidounces (450 Cc.). Each fluidounce (30 Cc.) represents about 1 grain of Opium (0.06).

CHLORALIS ET POTASSII BROMIDI COMPOSITA (Mixture of Chloral and Bromide).—Each fluidrachm (4 Cc.) contains 15 grains (1.), each, of Chloral and Potassium Bromide, and ⅛ grain (0.008), each, of Exts. Indian Cannabis and Hyoscyamus.

CHLOROFORMI ET CANNABIS INDICÆ COMPOSITA (*Chloroform Anodyne*).—Each fluidrachm (4 Cc.) represents 7½ minims (0.5 Cc.), each, of Chloroform and Tinct. Indian Cannabis; 3¾ minims (0.25 Cc.) Tinct. Capsicum; and about ⅐ grain (0.01) of Morphine Sulph.

CONTRA DIARRHŒAM (*Cholera Mixture*).—Tinctures of Opium, Capsicum, Rhubarb, and Spirits of Camphor and Peppermint, each, equal volumes.

The above formula appears to be that in most general use, also known under the name of "Sun Mixture."

Mistura—

Of other similar preparations in more or less general use, the following may be mentioned here:

2. *Loomis' Diarrhea Mixture.*—Tincture Opium, ½ fluidounce (15 Cc.); Tincture Rhubarb, ½ fluidounce (15 Cc.); Tincture Catechu Comp., 1 fluidounce (30 Cc.); Oil of Sassafras, 20 minims (1.3 Cc.); Tincture Lavender Comp., to make 4 fluidounces (120 Cc.).

3. *Squibb's Diarrhea Mixture.*—Tincture Opium, 1 fluidounce (30 Cc.); Tincture Capsicum, 1 fluidounce (30 Cc.); Spirit of Camphor, 1 fluidounce (30 Cc.); Purif. Chloroform, 180 minims (12 Cc.); Alcohol, enough to make 5 fluidounces (150 Cc.).

4. *Thielemann's Mixture* (Mixt. Thielemanni, Ph. Suec.).—Wine Opium, 1 fluidounce (30 Cc.); Tinct. Valerian, 1½ fluidounces (45 Cc.); Ether, ½ fluidounce (15 Cc.); Oil Peppermint, 60 minims (4 Cc.); Fl. Ex. Ipecac, 15 minims (1 Cc.); Alcohol, to make 4 fluidounces (120 Cc.).

5. *Velpeau's Diarrhea Mixture.*—Tincture Opium, Tincture Catechu Comp., Spirit Camphor, of each, equal volumes.

COPAIBÆ COMPOSITA—

1. *Lafayette Mixture.*—Copaiba, 2 fluidounces (60 Cc.); Tinct. Lavender Comp., 2 fluidounces (60 Cc.); Solution Potassa, ½ fluidounce (15 Cc.); Spirit Nitr. Ether, 2 fluidounces (60 Cc.); Syrup, 5 fluidounces (150 Cc.); Mucilage Dextrin, to make 16 fluidounces (450 Cc.). This mixture should be well agitated when used. Each fluidrachm contains 7½ minims of Copaiba.

2. *Chapman's Mixture.*—Copaiba, 4 fluidounces (125 Cc.); Tinct. Lav. Comp., 240 minims (15.5 Cc.); Tincture Opium, 240 minims (15.5 Cc.); Spirit Nitro. Ether, 4 fluidounces (125 Cc.); Mucilage Acacia, 1½ fluidounces (45 Cc.); Water, to make 16 fluidounces (450 Cc.).

EXPECTORANS, STOKES (Stokes' Expectorant).—Ammonium Carb., 120 grains (8.); Fl. Ext. Senega, ½ fluidounce (15 Cc.); Fl. Ext. Squill, ½ fluidounce (15 Cc.); Tinct. Opium, Camph., 2½ fluidounces (80 Cc.); Water, 1½ fluidounces (45 Cc.); Syrup Tolu, to make 16 fluidounces (450 Cc.).

GUAIACI (Guaiac Mixture, Ph. Br.).—Resin Guaiac, Sugar, each, 190 grains (12.5); Acacia Powder, 100 grains (7.); Cinnamon Water, 16 fluidounces (450 Cc.). To be well agitated when used.

Mistura—

MAGNESIÆ ET ASAFŒTIDÆ (U. S. P. 1880).—Dewees' Carminative.—Magnesium Carbonate, 90 grains (6.0); Tinct. Asafœtida, 2 fluidrachms (8 Cc.); Tinct. Opium, 20 minims (1.2 Cc.); Sugar, 180 grains (12.0); Water, to make 4 fluidounces (120 Cc.).

OLEI BALSAMICA (Balsamum Vitæ Hoffmanni, Ph. Ger.).—A solution of Oils of Lavender, Thyme, Lemon, Mace, Orange-flowers, Cloves, Cinnamon, and Balsam Peru in Alcohol.

OLEI PICIS (Tar Mixture).—A mixture of Oil of Tar, ½ fluidounce (15 Cc.); Chloroform, 75 minims (5 Cc.); Oil of Peppermint, 20 minims (1.3 Cc.), in Elixir, to make 16 fluidounces (450 Cc.).

RHEI COMPOSITA (Squibb's Rhubarb Mixture).—Fl. Ext. Rhubarb, 120 minims (6. Cc.); Fl. Ext. Ipecac, 16 minims (1. Cc.); Sodium Bicarb., 330 grains (11.); Glycerin, 6 fluidounces (240.), in Peppermint Water, 16 fluidounces (450 Cc.).

SASSAFRAS ET OPII (Mist. Opii Alkalina; Godfrey's Cordial).—A mixture of Oil of Sassafras, Tincture of Opium, and Potass. Carb. in Molasses, Alcohol, and Water. Each fluidrachm (4 Cc.) contains 2 minims (0.12) Tinct. Opium, corresponding to ⅛ grain (0.01) Opium.

SODÆ ET MENTHÆ (Soda Mint).—Sodium Bicarb., 320 grains (20.); Spirit Ammonia Arom., 4 Cc. (60 minims); Spearmint Water, 16 fluidounces (450 Cc.).

SPLENETICA (Spleen Mixture; Gadberry's Mixture).—Iron Sulphate, Quinine Sulphate, Nitric Acid, each, 100 grains (7.); Potassium Nitrate, 300 grains (20.), in Water, 16 fluidounces (450 Cc.).

SULPHURICA ACIDA (Haller's Acid Elixir, Ph. Ger.).—Sulphuric Acid, 1 part; Alcohol, to make 4 parts, by weight.

EMULSA—EMULSIONS.

Emulsions are liquid preparations consisting of *oily, fatty, resinous*, or otherwise *insoluble* substances suspended in watery liquids by the intervention of gum, mucilage, or other viscid matter. The object of emulsifying a substance is to render it easily miscible with water.

For the internal administration of Oils it is often necessary to exhibit them in a palatable form, so that they may be borne by the stomach and their assimilation favored. This is usually effected by

suspending the oil in a watery liquid or mixture by means of an *emulsifying agent*, such as acacia, etc.

Many natural substances are intimate mixtures of oils or fats with water, in the form of an emulsion. Of animal products, Milk is a most perfect emulsion; so is Egg-yolk. From the Milk-juice of some plants the water evaporates and the dried milk-juice collects in portions of the plant or exudes from them when wounded; in this way the gum-resins of asafœtida, etc., are produced. From these substances Emulsions may be obtained by restoring the water lost by evaporation—that is, by rubbing them with water in a mortar. In this way the so-called *natural* Emulsions are made.

Artificial Emulsions.

These are made by mixing the Oil with a certain proportion of the emulsifying agent, adding Water, and triturating the mixture in a mortar or agitating it in a flask.

There are various methods, but these are general rules:

The emulsification of the oil should be *complete* before the mixture is made up to the required measure.

When alcoholic liquids are to be added, they should first be *diluted* as much as possible.

Salts should be *dissolved* before being added.

No heat should be employed, as the oil *separates* when an emulsion is heated.

Emulsions should be *freshly* prepared and be preserved in a *cold* place.

The most common emulsifying agent is Powdered Gum Acacia (Acacia pulv.). The Oil is thoroughly mixed by trituration in a mortar with *one-fourth* its weight of powdered Acacia. To this *one and a half times as much* water as of gum is added *at once*, and the mixture is rapidly triturated with a rotary motion of the pestle until it becomes stiff and assumes a milk-white color. This so-called "mother-emulsion" may now be diluted to the required measure, and other substances, flavors, etc. be added.

Powdered Tragacanth may be used in the same way or in the form of mucilage, but it does not produce so permanent emulsions as does gum acacia.

The Mucilages of Acacia and of Irish Moss are not so satisfactory as powdered gum: while they produce a good emulsion, the division of the oil-globules is not so thorough as in the preceding: emulsification being incomplete, the mixture more rapidly separates into a heavier, watery liquid and a lighter, thick, gelatinous emulsion, which requires thorough mixing before use.

Extract of malt is an excellent emulsifying agent when its use is admissible. The Oil should be added to the Malt Extract contained in a capacious mortar, and incorporated in small quantities at a time. A good article will emulsify an equal volume of cod-liver oil.

Condensed Milk and Egg-yolk produce the most perfect emulsions, and also the most palatable, but they rapidly ferment and spoil.

Glycerin and sugar added to emulsions for the purpose of preservation and palatability induce separation, and their use is not advisable.

Emulsification "by intervention" is the best and only reliable method to be employed with Ethereal Oils and all substances of themselves not emulsifiable. The process is illustrated in the official Chloroform Emulsion.

Oil of Turpentine, for example, is emulsified by dissolving the Turpentine Oil in a bland fixed oil (Almond Oil), incorporating an equal weight of powdered Acacia, adding Water, and proceeding as with an ordinary emulsion.

Pancreatin emulsionizes fats in preparing them for digestion, but it does not produce a permanent emulsion when used artificially. While, therefore, not a reliable emulsifying agent, it aids the assimilation of oils, and its addition to emulsions is sometimes therapeutically desirable. As it is more active in alkaline media, the Emulsion should be prepared with a little Sodium Bicarbonate.

The addition of Alkalies to emulsions should be avoided. Soaps are not Emulsions, nor is the use of Soap-bark to be recommended.

The official emulsions are:

Emulsum—		*Gm. in 100 Cc., or percentage by vol.*
Amygdalæ	sweet almond	6.
	sugar 3; acacia	1.
Asafœtidæ	asafœtida, in select tears	4.
Chloroformi	tragacanth powd. 1; chloroform	4.
	expressed oil of almond	6.
Olei Morrhuæ	cod liver oil 50; oil of gaultheria 0.4; acacia 12.5; syrup	10.
Olei Morrhuæ cum Hypophosphitibus	cod liver oil 50; oil of gaultheria 0.4; syrup 10; calcium hypophosphite 1; potassium and sodium hypophosphites	0.5
Olei Terebinthinæ	rectified oil of turpentine	15.
	expressed oil of almond 5; syrup 25; acacia	15.

Unofficial Emulsions of the National Formulary.

Emulsions should, of all pharmaceuticals, be prepared within a reasonable period previous to the time of dispensing. A true emulsion should contain the oil simply suspended in the form of a mechanical mixture, which, from its very character, cannot withstand the effects of variation in temperature any better than a

natural emulsion, such as milk or emulsions of almonds, gum-resins, etc., and consequently quickly degenerates or spoils.

An emulsion may be perfect—that is, the oil-globules entirely extinguished—yet a separation similar to that occurring in milk will take place, which, though in its first stage not so objectionable, will eventually impair the medicinal value of the preparation. These reasons are, it is believed, sufficient to condemn the various "ready-made" or patent emulsions, and to justify the physician in prescribing such as are kept on hand by the pharmacist, in smaller quantities, prepared according to these formulas.

A typical formula for emulsions, with Acacia, is—

℞. Olei Morrhuæ . . . . 120 Cc., ℥iv;
Acaciæ pulv. . . . . 30 Gm., ℥j;
Aquæ. . . . . . . q. s. ad 240 Cc., ℥viij.

Emulsify by trituration in a mortar, and add the flavoring.

The following are flavors employed: (1) Gaultheria, (2) gaultheria and sassafras, (3) aromatic spirit, (4) gaultheria, bitter almond, and coriander, (5) gaultheria, sassafras, and bitter almond, (6) gaultheria and bitter almond, (7) oil of neroli, bitter almond, and cloves. Unless otherwise specified, that designated as No. 5 may be employed in these Emulsions.

The following formulas may be useful as indicating the form of prescription for any combination desired. Hypophosphite Salts or any medication desired may usually be dissolved in the water directed in the formula, should a preparation be indicated different from any of the following emulsions of the N. F.:

Emulsio—

OLEI MORRHUÆ CUM CALCII ET SODII PHOSPHATIBUS.—Calcium Phosphate, Sodium Phosphate, of each, 1 grain in 1 fluidrachm (0.06 in 4 Cc.).

OLEI MORRHUÆ CUM CALCII LACTOPHOSPHATE.—Calcium Lactophosphate, 3 grains in 1 fluidrachm (0.2 in 4 Cc.).

OLEI MORRHUÆ CUM CALCII PHOSPHATE.—Calcium Phosphate, 2 grains in 1 fluidrachm (0.12 in 4 Cc.).

OLEI MORRHUÆ CUM EXTRACTO MALTI.—Contains 40 per cent. Extract of Malt.

OLEI MORRHUÆ CUM HYPOPHOSPHITE.—The Hypophosphite Salt or any combination of the following: Calcium, Potassium, Sodium, or Iron, to be directed by the prescriber, 8 grains to the fluidounce (0.5 in 30 Cc.).

Emulsio—

OLEI MORRHUÆ CUM PRUNO VIRGINIANA.—Wild Cherry (Fluid Ext.), ½ fluidrachm to 1 fluidounce (2 Cc. in 30 Cc.).

OLEI RICINI.—1 fluidounce (30 Cc.) contains 2½ fluidrachms (10 Cc.) Castor Oil, disguised by the addition of Vanilla.

OLEI TEREBINTHINÆ.—Contains 1 fluidrachm (4 Cc.) Oil of Turpentine 1 fluidounce (in 30 Cc.), prepared according to the following formula:

℞. Olei Terebinthinæ	. . . . . . ʒiv,	12.5	Cc.;
Acaciæ pulv.	. . . . gr. xxx,	2.0	
Vitelli Ovi (Egg-yolk);			
Elixir Aromatici	. . . . ana ʒiv,	15	Cc.;
Aquæ Cinnamomi	. . q. s. ad ℥iv,	100	Cc.

Make an emulsion by trituration in a mortar.

PHOSPHATICA (Phosphatic Emulsion).—Prepared with Glycerite of Egg-yolk, and contains in 1 fluidounce (30 Cc.) Cod Liver Oil, 2 fluidrachms (8 Cc.); Dilute Phosphoric Acid, 22½ minims (1.5 Cc.); Jamaica Rum, flavored with Bitter Almond and Orange Flower Water.

EXTRACTIVE PREPARATIONS.

THE active medicinal constituents, or principles, of crude drugs are obtained by extraction. Extraction is effected either by maceration, expression, and filtration or straining, or by maceration with heat, when it is called digestion, or by percolation. The liquid employed, termed menstruum (pl. menstrua), may be Water or Alcohol, or Alcohol and Water in various proportions, sometimes with Glycerin. A few drugs require alkaline menstrua, some acid menstrua, while the oleoresins are made with Acetone (except Cubeb, which is made with Alcohol).

The Infusions and Decoctions are the simplest preparations made by extraction, and represent most nearly all the soluble constituents of the drugs. But not all drugs are adapted to this method of extraction nor to this exceedingly effective, though not especially elegant, form of exhibition. Also infusions and decoctions spoil easily unless alcohol is added as a preservative.

The most generally convenient and effective class of extractive preparations are the Tinctures. They are the simplest form of alcoholic preparations, and the other more concentrated preparations are

usually first obtained as tinctures and then concentrated by evaporation, so as to yield the fluidextract, extract, or resin respectively.

INFUSA—INFUSIONS.

Unless otherwise directed, Infusions are prepared by the general official process:

The substance, coarsely comminuted	5 Gm.
Boiling Water	100 Cc.

Pour the boiling Water on the Drug, in a suitable vessel provided with a cover, and let it stand for half an hour; strain with expression and add enough Water through the strainer to make 100 Cc.

Caution.—The strength of Infusions of energetic or powerful substances should be especially prescribed. The following Infusions are official, being prepared of different strengths and by other processes than directed in the general formula.

		Gm. in 100 Cc.
Infusum Digitalis	. alcohol 10; cinnamon water 15; digitalis	1.5
Infusum Sennæ Comp. (Black Draught)	. . fennel 2; senna	6.
	manna, magnesium sulph., of each	12.

To allow the *emulsin* and *amygdalin* of wild cherry to react, with the production of hydrocyanic acid and oil of bitter almonds, the drug must first be macerated with cold water, and is then extracted by percolation.

		Gm. in 100 Cc.
Infusum Pruni Virginianæ	. . . . wild cherry	4.

Unofficial Infusions of the National Formulary.

Infusum—

BRAYERÆ (U. S. P. 1880).—Brayera (Cusso), 6; Boiling Water, 100 Cc. To be dispensed without straining the mixture.

GENTIANÆ COMPOSITUM FORTIUS.—For preparing Infusum Gentianæ Compositum by mixing 1 volume with 3 volumes of water.

ROSÆ COMPOSITUM (Compound Infusion of Rose, Ph. Br.).—An infusion of Red Rose in diluted Sulphuric Acid, Sugar, and Water.

The Species (Teas) are mixtures of drugs contused or bruised for the preparation of Cataplasms; or Infusions and Decoctions, sometimes designated as *Haustus* (Draught). The following are in the National Formulary:

Species—

EMOLLIENTES (Emollient Cataplasm, Ph. Ger.).—A mixture of Althæa Leaves, Mallow Leaves, Melilot Tops, Matricaria, and Flaxseed, equal parts of each.

LAXANTES (St. Germain Tea, Ph. Ger.).—A mixture of Senna, Elder-flowers, Fennel, Anise, and Potassium Bitartrate.

PECTORALES (Breast Tea, Ph. Ger.).—A mixture of Althæa, Coltsfoot, Glycyrrhiza, Anise, Mullein Flowers, and Orris Root.

Infusum Pectorale (Pectoral Infusion, or Infusion of Pectoral Species) is made by infusing 1 troy ounce (30 Gm.) of the above in the usual manner, so as to obtain 10 fluidounces (300 Cc.) of strained product.

DECOCTA—DECOCTIONS.

Unless otherwise directed, Decoctions are prepared according to the following general process:

The substance, coarsely comminuted	5 Gm.
Water, to make	100 Cc.

Pour the Water on the Drug, contained in a suitable vessel provided with a cover, bring it to a boil, and let it boil for fifteen minutes; let it cool to 40° C. (104° F.), express, strain, and add cold Water through the strainer to make 100 Cc.

Caution as with Infusions.

There are no official decoctions.

DECOCTUM ALOES COMPOSITUM, N. F., is a mixture of Ext. Aloes, Myrrh, Saffron, Potass. Carb., Ext. Glycyrrh., Tinct. Cardamom Comp., and Water.—*Extempore.*

ACETA—VINEGARS.

The Vinegars are made by extraction with Dilute Acetic Acid.

By maceration:

Acetum—		*Gm. in 100 Cc.*
Opii (Black Drop) . sugar 20; nutmeg 3;	powd. opium	10.
Scillæ	squill	10.

VINA—WINES.

The Wines are made by solution, by maceration, or by maceration and percolation. The Menstruum is White Wine (except in Wine of Coca) with or without the addition of Alcohol (added to aid in the extraction and the preservation). There are ten Wines official.

The Natural Wines: Vinum Album and Vinum Rubrum are treated under *Alcohol.*

Vinum—		Gm. in 100 Cc.
Antimonii	antimony, potass. tart.	0.4
Cocæ	(made with red wine) fluidextract	6.5
Colchici Seminis	colchicum seed	10.
Ergotæ	ergot	20.
Ferri	iron and ammonium citrate	4.
	syrup 10; tinct. sweet orange peel	6.
Ferri Amarum	soluble iron and quinine citrate	5.
(Bitter Wine of Iron)	tinct. sweet orange peel 6; syrup	30.
Ipecacuanhæ	alcohol 10; fluidext. ipecac	10.
Opii	cinnamon, cloves, each, 1; opium	10.

The *Dose* of the Vinegar and Wine of Opium is the same, 10 minims (0.6) representing 1 grain (0.06) *opii pulvis*. The dose of the Wine of Colchicum Seed is 30 minims (2 Cc.).

Unofficial Wines of the National Formulary.

The Wines, with a few exceptions, are prepared with White Wine (*Vinum album*, U. S.), usually with the addition of 10 per cent. of Alcohol, in order better to preserve the preparation.

Vinum—

ALOES (U. S. P. 1880).—Representing 6 per cent. of Aloes with Aromatics.

AURANTII.—Sherry Wine flavored with Orange.

AURANTII COMPOSITUM (Elixir Aurantiorum Compositum).—A combination of Bitter Orange Peel, Absinthium, Menyanthes, Cascarilla, Cinnamon, and Gentian, in Sherry Wine. Useful as a stomachic tonic in doses of 1 fluidrachm (4 Cc.).

CARNIS (Beef and Wine).—Each fluidrachm (4 Cc.) represents 2 grains (0.12) of Extract of Beef.

The Extract of Beef in this and similar preparations is that which is prepared by Liebig's method.

CARNIS ET FERRI (Beef, Wine, and Iron).—Each fluidrachm (4 Cc.) represents 2 grains (0.12) of Extract of Beef and 2 minims (0.12) Tincture of Citro-chloride ("Tasteless" Tincture) of Iron.

CARNIS, FERRI ET CINCHONÆ (Beef, Wine, Iron, and Cinchona).—Each fluidrachm (4 Cc.) represents 2 grains (0.12) Extract of Beef, 2 minims (0.2) Tincture Citro-chloride of Iron, and small quantities of Cinchona alkaloids, in Angelica Wine.

COCÆ (ERYTHROXYLI).—Each fluidounce (30 Cc.) represents 30 grains (2 Gm.) of Coca in Claret Wine.

Vinum—

Cocæ Aromaticum.—Each fluidounce (30 Cc.) represents 30 grains (2 Gm.) of Coca with Aromatics.

Fraxini Americanæ (White Ash).—Each fluidrachm (4 Cc.) represents 30 grains (2 Gm.) of Fraxinus (bark).

Pepsini (Pepsin).—Each fluidrachm (4 Cc.) represents 1 grain (0.06) of Pepsin.

Picis (Tar).—A saturated solution of Tar, in Sherry Wine.

Pruni Virginianæ (Wild Cherry).—Each fluidrachm (4 Cc.) represents 15 grains (1 Gm.) of Wild Cherry, in Angelica Wine.

Pruni Virginianæ Ferratum (Wild Cherry, Ferrated).—Each fluidrachm (4 Cc.) represents 5 minims (0.3 Cc.) of Tincture of Citro-chloride of Iron and 13¾ grains (0.9 Gm.) of Wild Cherry, in Angelica Wine.

Rhei (U. S. P. 1880).—Representing 10 per cent. of Rhubarb and 1 per cent. of Calamus.

TINCTURÆ—TINCTURES.

Tinctures are liquid preparations made by the extraction of Drugs with menstrua of Alcohol and Water in various proportions. They are prepared by maceration and filtration or by percolation (the tinctures of iodine and nux vomica are made by simple solution).

In the Eighth Decennial (1905) Revision of the United States Pharmacopœia a number of the tinctures have been changed in strength to correspond with the tinctures used in other countries. For the following, also, assay processes have been introduced: Aconite, Belladonna Leaves, Cinchona, Colchicum Seed, Hydrastis, Hyoscyamus, Iodine, Nux Vomica, Opium, Deodorized Opium, Physostigma, and Stramonium.

Tincturæ Herbarum Recentium.—Tinctures of Fresh Herbs, or "Green Tinctures," similar to the Homœopathic or so-called "German Tinctures," also to the specific tinctures of the Eclectics, when not otherwise directed are to be prepared by the following general formula:

Take of the fresh herb, cut, bruised, or crushed, 50 Gm.; macerate for fourteen days in Alcohol 100 Cc.; express the liquid and filter.

Tinctures of the U. S. P.

Name. Tinctura—	*Drug.*	*Gm. in 100 Cc.*	*Menstrua. Alcohol, per cent.*	*U. S. P. Average Dose.* Cc.	*Min.*
Aconiti	Root	10	70	0.6	10
Aloes	Aloes	10	50	2.	30
	Licorice	20			
Aloes et Myrrhæ	Aloes	10	75	2.	30
	Myrrh	10			
	Licorice	10			
Arnicæ	Flowers	20	50	1.	15
Asafœtidæ	Gum resin	20	100	1.	15
Aurantii Amari	Bitter Orange peel	20	60	4.	60
Aurantii Dulcis	Sweet	50	100	4.	60
Belladonnæ Foliorum	Leaves	10	50	0.5	8
Benzoini	Balsam	20	100	1.	15
Benzoini Composita (Turlington's Balsam).	Benzoin	12	100	2.	30
	Storax	8			
	Tolu	4			
	Aloes	2			
Calendulæ	Florets	20	100	2.	30
Calumbæ	Root	20	60	4.	60
Cannabis Indicæ	Flower tops	10	100	0.6	10
Cantharidis	Insect	10	100	0.3	5
Capsici	Fruit	10	95	0.5	8
Cardamomi	Fruit	20	50	4.	60
Cardamomi Composita	Cardamom	2.5	50	4.	60
	Saigon Cinnam.	2.5			
	Caraway	1.2			
	Cochineal	0.5			
	Glycerin	5			
Cimicifugæ	Rhizome	20	100	4.	60
Cinchonæ	Bark	20	67	4.	60
Cinchonæ Composita (Huxham's Tincture).	Red Cinchona	10	67	4.	60
	Bitter Orange peel	8			
	Serpentaria	2			
	Glycerin	7.5			
Cinnamomi	Saigon	20	67	2.	30
Colchici Seminis	Seed	10	60	2.	30
Digitalis	Leaves	10	50	1.	15
Ferri Chloridi	Solution	35 Cc.	65	0.5	8
Gallæ	Nutgall	20	90	4.	60
Gambir Composita	Gambir	5	50	4.	60
	Saigon Cinnam.	2.5			
Gelsemii	Root	10	65	0.5	8
Gentianæ Composita	Gentian	10	60	4.	60
	Bitter Orange peel	4			
	Cardamom	1			
Guaiaci	Resin	20	100	4.	60
Guaiaci Ammoniata	Resin	20	. .	2.	30
Hydrastis	Rhizome	20	65	4.	60
Hyoscyami	Herb	10	50	1.	15

Name.	Drug.	Gm. in 100 Cc.	Menstrua. Alcohol, per cent.	U. S. P. Average Dose. Cc.	Min.
Tinctura—					
Iodi	Iodine Potass. Iodide	7 5	100	0.1	1½
Ipecacuanhæ et Opii	Ipecac Opium deod.	10 10	50	0.5	8
Kino	Insp. juice	5	65	4.	60
Krameriæ	Rhatany	20	50	4.	60
Lactucarii	Insp. juice	50	50	2.	30
Lavandulæ Composita	Oil Lavender Oil Rosemary Cinnamon Cloves Nutmeg Red Saunders	0.8 0.2 2. 0.5 1. 1.	75	2.	30
Limonis Corticis	Fresh peel	50	100		
Lobeliæ	Herb	10	50	1. 4.	15[1] 60[2]
Moschi	Musk	5	50	4.	60
Myrrhæ	Gum resin	20	100	1.	15
Nucis Vomicæ	Extract	2	75	0.6	10
Opii	Gran. Opium	10	50	0.5	8
Opii Camphorati (Paregoric).	Opium pulv. Acid Benzoic Camphor Oil Anise Glycerin	0.4 0.4 0.4 0.4 4	50	8.	120
Opii Deodorati	Gran. Opium	10	20	0.5	8
Physostigmatis	Calabar Bean	10	100	1.	15
Pyrethri	Pellitory	20	100		
Quassiæ	Wood	20	35	2.	30
Quillajæ	Soap Bark	20	35		
Rhei	Rhubarb Cardamom Glycerin	20 4 10	50	4.	60
Rhei Aromatica (for syrup).	Rhubarb Cinnamon Cloves Nutmeg Glycerin	20 4 4 2 10	50	2.	30
Sanguinariæ	Blood-root	10	60	1.	15
Scillæ	Squill	10	75	1.	15
Serpentariæ	Rhizome	20	65	4.	60
Stramonii	Leaves	10	50	0.5	8
Strophanthi	Seed	10	65	0.5	8
Tolutana	Tolu	20	100	2.	30
Valerianæ	Root	20	75	4.	60
Valerianæ Ammoniata	Root	20	..	2.	30
Vanillæ	Fruit	10	65		
Veratri	Rhizome	10	100	1.	15
Zingiberis	Ginger	20	100	2.	30

[1] Expectorant. [2] Emetic.

Unofficial Tinctures of the National Formulary.

Tinctura—

AMARA (Bitter Tincture, Ph. Ger.).—Containing Gentian, Centaury, Bitter Orange Peel, Orange Berries, and Zedoary.

ANTACRIDA (Dysmenorrhœa Mixture; Fenner's Guaiac Mixture).—A mixture of Guaiac, Canada Turpentine, Oil of Sassafras, and ⅛ grain (0.02) Corrosive Mercuric Chloride in each fluidrachm (4 Cc.). *Dose*, from 10 to 20 minims (0.6 to 1.3 Cc.).

ANTIPERIODICA (Warburg's Tincture).—*With Aloes:* Rhubarb, Angelica Seed, of each, grains 56 (4.); Elecampane, Saffron, Fennel, of each, grains 28 (2.); Aloes (aq. ext.), Gentian, Zedoary, Cubeb, Myrrh, White Agaric, Camphor, of each, grains 14 (1.); Quinine Sulphate, grains 160 (10.); Diluted Alcohol, enough to make fluidounces 16 (473 Cc.).

ANTIPERIODICA (Warburg's).—The preceding *without Aloes.* Each fluidounce (30 Cc.) of either tincture contains 10 grains (0.6) of Quinine Sulphate.

AROMATICA (Stomachic, Ph. Ger.).—A combination of Cinnamon, Ginger, Galangal, Cloves, and Cardamom.

CAPSICI ET MYRRHÆ (Hot Drops).—The preparation popularly known as "Number Six."

CINCHONÆ DETANNATÆ.—For admixture with preparations containing Iron.

CONII (U. S. P. 1880).—Representing 15 per cent. of Conium.

COTO.—This preparation contains 7½ grains (0.5) true Bolivian Bark in each fluidrachm (4 Cc.). The Para Coto, frequently employed, differs considerably from the above.

FERRI CHLORIDI ÆTHEREA (Bestucheff's Tincture; Lamott's Drops, Ph. Ger.).—Each fluidrachm (4 Cc.) represents about ½ grain (0.3) Metallic Iron.

FERRI CITRO-CHLORIDI (Tasteless Tincture of Iron).—Practically identical in the strength of Iron, but not in Alcohol, with the official Tincture of Chloride of Iron, containing an amount of Iron equivalent to 7½ grains (0.5) of Dry Chloride of Iron in each fluidrachm (4 Cc.).

A convenient form of Iron for admixture with Tinctures of vegetable astringent drugs, such as Gentian and Cinchona, preparations of which it does not, unlike other iron compounds, discolor.

FERRI POMATA (Ferrated Extract of Apples; Malate of Iron, Ph. Ger.).—Each fluidrachm (4 Cc.) represents about ⅜ grain (0.025) of Metallic Iron.

Tinctura—

GUAIACI COMPOSITA (Dewees' Tincture of Guaiac).—Each fluidrachm (4 Cc.) represents 7½ grains (0.5) Guaiac.

IGNATIÆ (U. S. P. 1880).—Representing 10 per cent. of Ignatia.

IODI (Churchill's).—A solution of 10 grains (0.6) Iodine in each fluidrachm (4 Cc.), with Potassium Iodide in Alcohol.

Not to be confounded with Churchill's Iodine Caustic (Liquor Iodi Causticus).

IODI DECOLORATA (Colorless Tincture of Iodine).—Containing about 1 per cent. of Ammonium Iodide, with some other Iodine compounds, in alcoholic solution; for external use.

JALAPÆ (U. S. P. 1870).—Each fluidrachm (4 Cc.) represents about 10 grains (0.6) Jalap.

JALAPÆ COMPOSITA.—Each fluidrachm (4 Cc.) represents 7½ grains (0.5) Jalap and about 2 grains (0.12) Scammony.

KINO COMPOSITA—

Tinctures of Kino, Opium, each	minims	180	12.	Cc.
Spirit of Camphor	"	130	8.5	"
Oil of Cloves	"	2½	0.15	"
Aromatic Spirit of Ammonia	"	15	1.	"
Cochineal	grains	16	1.	"
Diluted Alcohol to make fluidounces		4	120.	"

Each fluidrachm (4 Cc.) represents ½ grain (0.03), each, of Kino and Opium.

PAPAVERIS (Poppy).—Each fluidrachm (4 Cc.) represents 30 grains (2.) of Poppy (Capsule).

PECTORALIS (Bateman's Pectoral Drops).—A popular mixture of Opium, Catechu, Camphor, and Oil of Anise, containing 2½ minims (0.15) Tincture of Opium (¼ grain Pulv. Opium) in each fluidrachm (4 Cc.).

PERSIONIS (Cudbear).—Intended as a coloring agent when a bright-red tint or color is to be produced, particularly in acid liquids.

PERSIONIS COMPOSITA.—A mixture of Cudbear and Caramel, intended as a coloring agent when a brownish-red tint or color is to be reproduced.

PIMPINELLÆ (Pimpinella, Ph. Ger.).—Each fluidrachm (4 Cc). represents about 10 grains (0.6) Pimpinella Root.

RHEI AQUOSA (Rhubarb, Aqueous, Ph. Ger.).—Each fluidrachm (4 Cc.) represents about 5⅝ grains (0.4) of Rhubarb, with alkalies, flavored with Cinnamon.

Tinctura—

RHEI ET GENTIANÆ.—Each fluidram (4 Cc.) represents 5 grains (0.3) of Rhubarb and 1 grain (0.06) of Gentian.

RHEI VINOSA (Rhubarb, Vinous, Ph. Ger.).—Each fluidrachm (4 Cc.) represents about 5 grains (0.3) Rhubarb, with Bitter Orange and Cardamom, in Sweet Sherry Wine.

SAPONIS VIRIDIS COMPOSITA.—A solution of about 15 per cent. of Green Soap and 2 per cent. of Oil of Cade.

TINCTURÆ ÆTHEREÆ (Ethereal Tinctures).—The drug, properly comminuted, troy ounces 2 (60 Gm.); Stronger Ether, 1 volume; Alcohol, 2 volumes; enough to make fluidounces 16 (473 Cc.). A general formula for the preparation of Ethereal Tinctures of Belladonna, Castor, Digitalis, Lobelia, Valerian, and other drugs. Official in several European pharmacopœias, and sometimes prescribed by foreign physicians.

TOLUTANA SOLUBILIS (Tolu, Soluble).—A so-called soluble essence of Tolu, for flavoring.

VANILLINI COMPOSITA.—A solution of Vanillin and Coumarin, intended for flavoring.

ZEDOARIÆ AMARA (Zedoary Comp.).—Similar to, but not identical with, the Tinctura Carminativa, Wedelii, etc., formerly official in some Continental pharmacopœias.

Each fluidrachm (4 Cc.) represents 15 grains (1 Gm.) of Zedoary, 7½ grains (0.5) of Aloes, and 3¾ grains (0.25), each, of Rhubarb, Gentian, White Agaric, and Saffron.

FLUIDEXTRACTA—FLUIDEXTRACTS.

Fluidextracts may be defined as a class of concentrated tinctures of such strength as to represent the drug, *volume for weight.* They are made by *percolation*, *maceration*, or *digestion.*

The following is the process of percolation chiefly employed:

In proceeding to percolate 100 Gm. of the drug, according to directions, the first 80 to 90 Cc. are reserved, and percolation continued until the exhaustion is completed. The weak percolate is evaporated to a soft extract (the alcohol being recovered) and dissolved in the reserved percolate. Sufficient menstruum is then added to make the product measure 100 Cc.

The Pharmacopœia gives assay processes for the Fluidextracts of Aconite, Belladonna Root, Cinchona, Coca, Colchicum Seed, Conium, Guarana, Hydrastis, Hyoscyamus, Ipecac, Nux Vomica, Pilocarpus, Scopola, and Stramonium.

Official Name.	*Drug.*	*Part.*	U. S. P. Average Dose. *Cc.*	*Minims*
Fluidextractum—				
Aconiti	Aconitum Napellus	Tuber	0.05	1
Apocyni	Apocynum Cannabinum	Root	1.	15
Aromaticum	Pulvis Aromaticus		1.	15
Aurantii Amari	Citrus vulgaris	Rind	1.	15
Belladonnæ Radicis	Atropa Belladonna	Root	0.05	1
Berberidis	Berberis Aquifolium	Rhizome	2.	30
Buchu	Barosma betulina	Leaves	2.	30
Calami	Acorus Calamus	Rhizome	1.	15
Calumbæ	Jateorrhiza palmata	Root	2.	30
Cannabis Indicæ	Cannabis sativa	Fl. Tops	0.05	1
Capsici	Capsicum fastigiatum	Fruit	0.05	1
Chimaphilæ	Chimaphila umbellata	Leaves	2.	30
Chiratæ	Swertia Chirata	Plant	1.	15
Cimicifugæ	Cimicifuga racemosa	Rhizome	1.	15
Cinchonæ	Cinchona Calisaya	Bark	1.	15
Cocæ	Erythroxylon Coca	Leaves	2.	30
Colchici Seminis	Colchicum autumnale	Seed	0.2	3
Conii	Conium maculatum	Fruit	0.2	3
Convallariæ	Convallaria majalis	Rhizome	0.5	8
Cubebæ	Piper Cubeba	Fruit	1.	15
Cypripedii	Cypripedium pubescens	Rhizome	1.	15
Digitalis	Digitalis purpurea	Leaves	0.05	1
Ergotæ	Claviceps purpurea	Sclerotium	2.	30
Eriodictyi	Eriodictyon glutinosum	Leaves	1.	15
Eucalypti	Eucalyptus globulus	Leaves	2.	30
Euonymi	Euonymus atropurpureus	Bark	0.5	8
Eupatorii	Eupatorium perfoliatum	Herb	2.	30
Frangulæ	Rhamnus Frangula	Bark	1.	15
Gelsemii	Gelsemium sempervirens	Rhizome	0.05	1
Gentianæ	Gentiana lutea	Root	1.	15
Geranii	Geranium maculatum	Rhizome	1.	15
Glycyrrhizæ	Glycyrrhiza glabra	Root	2.	30
Granati	Punica Granatum	Bark	2.	30
Grindeliæ	Grindelia robusta	Leaves	2.	30
Guaranæ	Paullinia Cupana	Seeds	2.	30
Hamamelidis Foliorum	Hamamelis Virginiana	Leaves	2.	30
Hydrastis	Hydrastis Canadensis	Rhizome	2.	30
Hyoscyami	Hyoscyamus niger	Herb	0.2	3
Ipecacuanhæ	Cephaëlis Ipecacuanha	Root:		
		Emetic	1.	15
		Expectorant	0.05	1
Krameriæ	Krameria triandra	Root	1.	15
Lappæ	Arctium Lappa	Root	2.	30
Leptandræ	Veronica Virginica	Rhizome	1.	15
Lobeliæ	Lobelia inflata	Herb	0.5	8
Lupulinæ	Humulus Lupulus	Powder	0.5	8
Matico	Piper angustifolium	Leaves	4.	60

Official Name.	*Drug.*	*Part.*	*U. S. P. Average Dose.* Cc.	Minims.
Fluidextractum—				
Mezerei	Daphne Mezereum	Bark		
Nucis Vomicæ	Strychnos Nux-vomica	Seed	0.05	1
Pareiræ	Chondodendrum tomentosum	Root	2.	30
Phytolaccæ	Phytolacca decandra	Root:		
		Emetic	1.	15
		Alterative	0.1	1½
Pilocarpi	Pilocarpus Jaborandi	Leaves	2.	30
Podophylli	Podophyllum peltatum	Rhizome	0.5	8
Pruni Virginianæ	Prunus serotina	Bark	2.	30
Quassiæ	Picræna excelsa	Wood	0.5	8
Quercus	Quercus alba	Bark	1.	15
Quillajæ	Quillaja saponaria	Bark	0.2	3
Rhamni Purshianæ	(Cascara sagrada)	Bark	1.	15
Rhamni Purshianæ Aromaticum	Rhamnus Purshiana, Glycyrrhiza, Compound spirit of orange		1.	15
Rhei	Rheum officinale	Root	1.	15
Rhois Glabræ	Rhus glabra	Leaves	1.	15
Rosæ	Rosa Gallica	Petals	2.	30
Rubi	Rubus villosus	Root Bark	1.	15
Sabinæ	Juniperus Sabina	Tops	0.3	5
Sanguinariæ	Sanguinaria Canadensis	Rhizome	0.1	1½
Sarsaparillæ	Smilax officinalis, etc.	Root	2.	30
Sarsaparillæ Compositum	Sarsaparilla, 75; Glycyrrhiza, 12; Sassafras, 10; Mezereum, 3		2.	30
Scillæ	Urginea maritima	Bulb	0.1	1½
Scopolæ	Scopola Carniolica	Rhizome	0.05	1
Scutellariæ	Scutellaria lateriflora	Herb	1.	15
Senegæ	Polygala Senega	Root	1.	15
Sennæ	Cassia acutifolia and angustifol.	Leaves	2.	30
Serpentariæ	Aristolochia Serpentaria	Rhizome	1.	15
Spigeliæ	Spigelia Marilandica	Rhizome	4.	60
Staphisagriæ	Delphinium Staphisagria	Seed	0.05	1
Stillingiæ	Stillingia sylvatica	Root	2.	30
Stramonii	Datura Stramonium	Leaves	0.05	1
Sumbul	(undetermined)	Rhizome	2.	30
Taraxaci	Taraxacum officinale	Root	8.	120
Tritici	Agropyrum repens	Rhizome	8.	120
Uvæ Ursi	Arctostaphylos Uva Ursi	Leaves	2.	30
Valerianæ	Valeriana officinalis	Rhizome	2.	30
Veratri	Veratrum viride	Rhizome	0.1	1½
Viburni Opuli	(Cramp bark)	Bark	2.	30
Viburni Prunifolii	(Black haw)	Bark	2.	30
Xanthoxyli	Xanthoxylum Americanum	Bark	2.	30
Zingiberis	Zingiber officinale	Rhizome	1.	15

Unofficial Fluidextracts of the National Formulary.

Unless otherwise indicated, the dose of the following Fluid-extracts is from ½ to 1 fluidram (2 to 4 Cc.):

Fluidextractum—

ADONIDIS.—Root of Adonis vernalis L. (Bird's Eye).

ALETRIDIS.—Rhizome of Aletris farinosa L. (Stargrass).

ANGELICÆ RADICIS.—Root of Archangelica L. (Angelica).

APII GRAVEOLENTIS.—Seed of Apium graveolens L. (Celery).

ARALIÆ RACEMOSÆ.—Root of Aralia racemosa L. (American Spikenard).

ARNICÆ FLORUM.—Flower heads of Arnica montana L. (Arnica).

BERBERIDIS VULGARIS.—Bark of the root of Berberis vulgaris L. (Barberry).

BOLDI.—Leaves of Peumus Boldus Molina (Boldo).

BUCHU COMPOSITUM.—A combination of Buchu, 10; Cubeb, 2; Juniper, 2; Uva Ursi, 2 parts.

CALENDULÆ.—Flowering herb of Calendula officinalis L. (Marigold).

CAMELLIÆ.—Leaves of Camellia Thea Link (Tea). The best quality of commercial black tea, "Formosa Oolong," to be employed for this preparation.

CAULOPHYLLI.—Rhizome and rootlets of Caulophyllum thalictroides Mich. (Blue Cohosh).

COFFEÆ VIRIDIS.—Unroasted seeds of Coffea Arabica L.

COFFEÆ TOSTÆ.—Roasted seeds of Coffea Arabica L.

The N. F. recommends equal portions of Java and Mocha to be employed in preparing the Fluid Extracts of Coffee.

CONVALLARIÆ FLORUM.—Flowers of Convallaria majalis L. (Lily of the Valley).

COPTIS.—Rhizome of Coptis trifolia Salisb. (Goldthread).

CORNUS CIRCINATÆ.—Bark of Cornus circinata L'Hér. (Green Osier.)

CORNUS FLORIDÆ (U. S. P. 1880).—Dogwood Bark.

CORYDALIS.—Tubers of Dicentra Canadensis De C. (Turkey Corn).

COTO.—Coto bark, undetermined tree. *Dose*, from 5 to 15 minims (0.3 to 1 Cc.).

FUCI.—Thallus of Fucus vesiculosus L. (Bladder-wrack).

Fluidextractum—

HELIANTHEMI.—Herb of Helianthemum Canadense Mich. (Frost-wort).

HUMULI.—Strobiles of Humulus Lupulus L. (Hops).

HYDRANGEÆ.—Root of Hydrangea arborescens L. (Seven Barks).

JALAPÆ.—Tuber of Exogonium purga Benth. (Jalap). *Dose*, from 15 to 20 minims (1 to 1.3 Cc.).

JUGLANDIS.—Bark of the root of Juglans cinerea L. (Butternut).

JUNIPERI.—Fruit of Juniperus communis L.

KAVA.—Root of Piper methysticum Forster (Kava; Kava-Kava).

LACTUCARII (U. S. P. 1880).—Insp. juice of Lactuca virosa L.

MALTI.—(Fluid Extract of Malt).

MENYANTHIS.—Leaves of Menyanthes trifoliata L. (Buckbean; Trifolium fibrinum, Ph. G.).

MEZEREI (U. S. P. 1880).—Bark of Daphne Mezereum L. *Dose*, from 5 to 10 minims (0.3–0.6 Cc.).

PETROSELINI RADICIS.—Root of Petroselinum sativum Hoffman (Parsley).

QUILLAJÆ.—Bark of Quillaja Saponaria Molina (Soap Bark).

RHAMNI PURSHIANÆ AROMATICUM.—Cascara Sagrada deprived of its bitter taste.

RHEI AROMATICUM.—A combination of Rhubarb, Cinnamon, Cloves, and Nutmeg.

SENNÆ DEODORATUM (Aqueous Fluid Extract of Senna).—This preparation is free from the objectionable "griping" qualities of the ordinary fluid extract.

STERCULIÆ.—Seeds of Sterculia acuminata R. Brown (Cola or Kola).

STILLINGIÆ COMPOSITUM (Stillingia Comp.).—Stillingia, Corydalis, each, 4 parts; Iris, Sambucus, Chimaphila, each, 2 parts; Coriander, Xanthoxylum Berries, each, 1 part.

TRILLII.—Rhizome of Trillium erectum L. (Bethroot).

TURNERÆ.—Leaves of Turnera microphylla De C. (Damiana).

URTICÆ.—Root of Urtica dioica L. (Nettle).

VERBASCI.—Leaves (and flowers) of Verbascum Thapsus L.

VERBENÆ.—Root of Verbena hastata L. (Vervain).

ZEÆ.—Stigmatum Maydis; Corn Silk; Stigmata of Zea Mays L. (Indian Corn).

EXTRACTA—EXTRACTS.

Extracts—or "solid" extracts, as they are termed, to distinguish them from fluidextracts—are the soluble principles of vegetable drugs, extracted and concentrated by evaporation to a soft solid or a plastic mass of pilular consistence, or dried and reduced to powder.

Table Showing the Drug-strength and the Average Doses of the Official Extracts.

Extractum.	Part.	Parts of Drug in 1 part of Extract (Approximate.)	Dose of Extract.	
			Grains.	Gm.
Aloes (aqueous)		2	2	0.125
Belladonnæ Fol.	Leaves	5	$\frac{1}{5}$	0.01
Cannabis Indicæ	Herb	10	$\frac{1}{6}$	0.01
Cimicifugæ	Rhizome	10	4	0.25
Colchici Cormi (acetic)	Corm	3	1	0.065
Colocynthidis (powder)	Fruit	6	$\frac{1}{2}$	0.03
Colocynthidis Compositum (powder)	Ext. Colocynth, 16; Cardamom, 6; Aloes, 50; Soap, Scammony, each, 14.	. .	$7\frac{1}{2}$	0.5
Digitalis	Leaves	4	$\frac{1}{6}$	0.01
Ergotæ	Sclerotium	8	4	0.25
Euonymi	Bark	4	2	0.125
Gentianæ (aqueous)	Root	4	4	0.25
Glycyrrhizæ (stick)	Root	3	15	1.
Glycyrrhizæ Purum (ammon.)	Root	3	15	1.
Hæmatoxyli (aqueous)	Logwood	4	15	1.
Hyoscyami	Herb	6	1	0.065
Krameriæ (aqueous)	Root	5	$7\frac{1}{2}$	0.5
Leptandræ	Root	4	4	0.25
Malti	Liquid	. .	ʒiv	16 Cc.
Nucis Vomicæ (powder)	Seed	10	$\frac{1}{4}$	0.015
Opii (powder)		$1\frac{2}{3}$	$\frac{1}{2}$	0.03
Physostigmatis	Calabar bean	20	$\frac{1}{8}$	0.008
Quassiæ (aqueous	Wood	10	1	0.065
Rhamni Purshianæ	Bark	4	4	0.25
Rhei	Root	3	4	0.25
Scopolæ	Rhizome	5	$\frac{1}{6}$	0.01
Stramonii	Leaves	10	$\frac{1}{6}$	0.01
Sumbul	Rhizome	. .	4	0.25
Taraxaci (aqueous)	Root	3	15	1.

The *strength* of an extract depends upon the amount of the crude drug it represents. Hence, the *smaller* the percentage of extract obtained from a drug, the *greater* the relative strength of the extract, provided that the drug be exhausted with menstrua adapted to secure all the active principles in this form.

The yield of extract is influenced by the character of the menstruum employed. As a general rule, the more *aqueous* the men-

strua, the *greater* the yield of extract; conversely, the more *alcoholic* the menstrua, the *smaller* the yield of extract. To obtain the extracts, therefore, of official *strength* it is necessary to use official *menstrua* in the extraction.

Thus the extracts of different drugs are as many times stronger than the drug as the quotient obtained by dividing the drug at 100 by the percentage yield. For example: Podophyllum yields 10 per cent. of extract; then $100 \div 10 = 10$; that is, the extract is ten times as strong as the drug and the fluid extract, or 0.1 of the extract represents 1 Gm. of the drug or 1 Cc. of the fluid extract. The drug-strengths of the official Extracts, calculated by this method, as well as their relative doses based upon the amounts of drug they represent, are exhibited in the table given on page 109.

The official Extracts are made by extraction with alcoholic menstrua or with water, sometimes by the addition of *acid* or *alkali*.

The Extracts of Cimicifuga, Colocynth, Colocynth Compound, Euonymus, Leptandra, Nux Vomica, Opium, Physostigma, Quassia, and Rhamnus Purshiana, are in powdered form; the others are of pilular consistence.

The Pharmacopœia gives assay processes for the following extracts: Belladonna Leaves, Colchicum Corm, Hyoscyamus, Nux Vomica, Opium, Physostigma, Scopola, and Stramonium.

Extractum Ferri Pomatum, N. F.—Ferri Malas Crudus (Ferrated Extract of Apples, Ph. Ger.).

Extractum Glycyrrhizæ Depuratum, N. F.—Succus Liquiritiæ, Ph. Ger. (Purified Extract of Liquorice).

OLEORESINÆ—OLEORESINS.

To natural Oleoresins, derived as plant-exudations, belong the Turpentines and the Pitches. From similar exudations are obtained the Gum Resins, mixtures of Gum and Resins and sometimes Volatile Oils; also the Balsams, which are Resins or Oleoresins associated with Benzoic or Cinnamic Acid. These are treated under their respective Drugs.

The *pharmaceutical* Oleoresins are semi-liquid extracts, obtained by exhausting oleoresinous drugs with acetone (alcohol is employed in the manufacture of Oleoresin of Cubeb).

This extracts *fixed* and *volatile oils* and *resin;* these principles constitute therefore the oleoresins, which sometimes also contain other active matter in solution or suspension.

The six following are official:

Oleoresina—	*Gm.*	*Gr.*
Aspidii; separates in two layers, to be mixed when used	2.	30
Capsici; separates fat, used only as corrective	0.03	½
Cubebæ; separates wax	0.5	7½
Lupulini	0.2	3
Piperis; separates piperine, to be rejected	0.03	½
Zingiberis	0.03	½

RESINÆ—RESINS.

The official Resins may be divided into the (1) Natural Resins, (2) Resins obtained from Oleoresins by separating the Volatile Oil by distillation, and (3) the Pharmaceutical Resins, prepared by *precipitation.*

When a concentrated tincture of a resinous drug is poured into a large quantity of cold water, the resinous matter becomes insoluble and is precipitated; this, after being washed, dried, and sometimes powdered, is termed a *resin.*

Resins are usually *soluble* in alkalies and *insoluble* in acids (dilute); for this reason the water used for precipitation is sometimes rendered slightly acid to favor the separation.

The three following are official:

Resina—	*Per cent. yield from Drug. About*	*Dose.* *Gm.*	*Gr.*
Jalapæ	15	0.125	2
Podophylli	5	purgative 0.015	¼
		laxative 0.005	$\frac{1}{10}$
Scammonii	65	0.2	3

Resina and Resina Copaibæ are obtained as residue in the distillation of the respective Oleoresins, Turpentine and Copaiba. The natural Resins are obtained as exudates—*e. g.* R. Guaiaci.

The terms *resin*, *resinoid*, and *concentration* are also applied to a class of preparations used by eclectic physicians, prepared by this general process with some modifications. (See U. S. and Am. Disp.) They are named after their respective Drugs with the ending *in*, as in Glucosides, and must not be confused with the latter. While the Glucosides are usually the active medicinal constituents representing the drug, the resinoids, with the exception of those made

from drugs whose active principles are resins, such as Cimicifuga and Podophyllum, are more or less inert, unreliable mixtures, too indefinite in their composition and strength for medicinal use.

SOLID MIXTURES FOR INTERNAL USE.

MIXTURES of Solids for internal use embrace the following classes of preparations: Powders, Effervescent Salts, Confections, Troches, Masses, and Pills.

Powders are substances reduced to a fine pulverulent condition to favor their administration and solution or absorption. A powder may be *simple*, such as a powdered drug, *Pulvis opii*, or a powdered salt—*i. e. Quininæ sulphas;* or it may be *compound*, a mixture of several substances.

Sparingly soluble substances, when finely powdered (impalpable) and thoroughly mixed by trituration in a mortar with some inert powder (diluent) such as Milk Sugar, are rendered more soluble, since a greater surface is exposed to the solvent action of the liquids of the body, and prompter and fuller effects are obtained. The potency of calomel, of the resins, and of alkaloids is in this way considerably increased within certain limits, but not to the unreasonable extent advocated by Homœopathic pharmacy, in which this process is carried to a *reductio ad absurdum*. It is an excellent and convenient method for dispensing and administering the more potent agents, such as arsenous acid, mercury compounds, and the alkaloids. Substances triturated in this way have been called *Triturations*, for whose preparation the U. S. P. gives a general formula. (*Trituratio Elaterini* is the only official trituration.):

Take of the substance, for example, Elaterin . . . 1 Gm.
Milk Sugar, in fine powder . . . . 9 Gm.

First thoroughly triturate the medicinal substance (Elaterin) with an equal weight of Milk Sugar, then add the remainder of the Milk Sugar, and mix thoroughly by trituration (for about ten minutes).

Unless otherwise specified, triturations should be of the official strength—*i. e.* 10 per cent. of the drug.

By the addition of about an equal weight of Alcohol to the triturate it becomes a soft mass, which, after being moulded into disks of about 1 grain (0.06 Gm.) each, after the evaporation of the

Alcohol, furnishes the so-called *Tablet Triturates.* These afford a convenient method of medication for such substances as are adapted to trituration, which is, however, confined, as indicated, to a comparatively limited number of agents. To represent in the form of these tablets every kind of medicinal agent of volatile character, or drugs otherwise susceptible to change through the inevitable exposure to the atmosphere to which every such mixture is liable, is simply to invite error in practice. These tablets, moreover, with certain chemical substances, undergo chemical changes which render them entirely insoluble, and thus practically inert. In order to be effective and otherwise reliable, they should be prepared extemporaneously by the pharmacist, in order to ensure their solubility.

They should always be dissolved in a little water before they are administered.

When it is desired to obtain a mild and prolonged local effect of a medicinal agent in the mouth or throat, the substance is made into a soft mass (*confection*) with a diluent and excipient, Sugar and Mucilage, and flavor, and formed into round or oval-shaped disks, weighing from 8 to 30 grains (½ to 2 Gm.), called variously Lozenges, Troches, and Pastils.

Troches.—When these are allowed to dissolve slowly in the mouth the diluent serves as a vehicle for the medicinal agent, and a gradual prolonged effect is obtained upon the mucous surfaces. This form of medication is adapted only to astringents, antacids, expectorants, and stomachics consisting of substances not especially disagreeable to the palate.

Lozenges are not intended to be swallowed, nor adapted to exceedingly volatile, caustic, irritant, or otherwise unpalatable substances. For ingestion, medicinal agents should be made into a Mass (*massa*) with an excipient, and formed into small spheres, or balls, as a rule not over 5 grains (0.3 Gm.) in weight, to be swallowed and slowly dissolved in the stomach or intestines. Such preparations are the so-called *Pills* (*Pilulæ*, from *pila*, ball). The medicinal substance may also be divided and placed in *Gelatin Capsules* or in *Rice-flour Cachets.*

PULVERES—POWDERS.

The official Powders are impalpable mixtures of one or more active drugs, usually with some nearly inert substance, such as Sugar, as a *diluent*, and Aromatics.

They are made by trituration.

Pulvis—		Gm. in 100.
Acetanilidi Compositus . .	acetanilide 70, caffein	10.
	sodium bicarbonate	20.
Aromaticus . .	cinnamon (Saigon), ginger, each	35.
	cardamom (seed), nutmeg, each	15.
Cretæ Compositus .	acacia p. 20; sugar 50; prep. chalk	30.
Glycyrrhizæ Compositus . .	senna 18; glycyrrhiza	23.6
	fennel oil 0.4; sulphur, washed, 8; sugar	50.
Ipecacuanhæ et Opii . .	ipecac, opium pulv., each	10.
(Dover's Powder)	sugar of milk	80.
Jalapæ Compositus . .	potass. bitartrate 65; jalap	35.
Morphinæ Compositus . .	camphor 32; morphine	
(Tully's Powder)	sulph.	1.5
	calcium carb., precip. 33.5; glycyrrhiza p.	33.
Rhei Compositus .	magnesium oxide 65; ginger 10;	
	rhubarb	25.

		For 12 pow.; Gm.	in each Gr.
Effervescens Compositus . .	(Seidlitz Powder)		
	potassium and sodium tartrate	93	120
	sodium bicarbonate	31	40
	acid tartaric	27	35

Many methods are in use for the purpose of disguising the taste of disagreeable remedies in the powder form. Of these the most elegant and effective method is that of enclosing the powder in a *cachet* or wafer. Originally wafers were made of starch-paste in thin sheets; a piece about 0.5 dcm. (2 inches) square, immersed in water for a minute, being placed in a spoon, the powder poured into it, and then enwrapped by folding up the edges and swallowed with a little water. The cachets or "konseals" are wafer-disks consisting of two concentric halves, one of which is filled with the powder, and the other half attached by moistening the edge and pressing the edges together by means of various devices. These cachets are of three sizes, the largest holding 5 grains (0.3) Quinine Sulphate. After a moment's immersion in water they can be swallowed without any effort.

Unofficial Powders of the N. F.

Pulvis—

ACACIÆ COMPOSITUS (Pulvis Gummosus, Ph. Ger.).

ACETANILIDI COMPOSITUS.—Containing 50 per cent. Acetan-

Pulvis—

ilid, 2 per cent. Caffeine, with Tartaric Acid and Sodium Bicarbonate.

ALOES ET CANELLÆ (Hiera Picra).

AMYGDALÆ COMPOSITUS (Almonds Comp.)—A mixture of Sweet Almond, Sugar, and Acacia, in fine powder; 180 grains (10 Gm.), triturated with Water, yield about 4 fluidounces (119 Cc.) of Emulsum Amygdalæ.

ANTICATARRHALIS (Catarrh Snuff.)—Hydrochlorate of Morphine, 1 part; Acacia, 60 parts; Subnitrate of Bismuth, 180 parts, in fine powder.

CATECHU COMPOSITUS (Compound Powder of Catechu, Ph. Br.). —Catechu, 4 parts; Kino, 2 parts; Krameria, 2 parts; Cinnamon, 1 part; Nutmeg, 1 part.

CRETÆ AROMATICUS.—A mixture of Cinnamon, Saffron, Nutmeg, Cloves, Cardamon, prepared Chalk, and Sugar.

CRETÆ AROMATICUS CUM OPIO.—Aromatic Powder of Chalk, with 1 grain (0.06) of powdered Opium, in 40 grains (1.5) of the mixture. Official in the Ph. Br.

HYDRARGYRI CHLORIDI MITIS ET JALAPÆ (Calomel and Jalap).—A mixture of Mild Chloride of Mercury, 10 grains (0.6), and Jalap, 20 grains (1.3).

When "Calomel and Jalap" is prescribed for an adult, without any specification of quantities, the N. F. recommends that the above mixture be dispensed as one dose.

IODOFORMI COMPOSITUS (Iodoform and Naphthalin).—A mixture of Iodoform, 2 parts; Boric Acid, 3 parts; Naphthalin, 5 parts; with Oil of Bergamot, in fine powder.

This powder is used in many cases where a diluted preparation of Iodoform, for external purposes, is desired. The odor is masked both by the Oil of Bergamot and by the Naphthalin.

KINO COMPOSITUS.—A mixture of Kino and Cinnamon, with 1 grain (0.06) of Powdered Opium in each 20 grains (1.3).

MYRICÆ COMPOSITUS (Composition Powder).—A mixture of Bayberry, Ginger, Capsicum, and Cloves.

PANCREATICUS COMPOSITUS (Peptonizing Powder).—A mixture of 20 parts Pancreatin and 80 parts Sodium Bicarbonate; 25 grains will peptonize 1 pint of milk.

PEPSINI COMPOSITUS (Pulvis Digestivus).—A mixture of Pepsin, Pancreatin, Diastase, Lactic and Hydrochloric Acids, with Milk Sugar to represent the gastric juice.

Pulvis—

Rhei et Magnesiæ Anisatus (Compound Anise Powder.)—A mixture of Rhubarb, Heavy Magnesia, and Oil of Anise.

Talci Salicylicus (Salicylated Powder of Talcum).—A mixture of Talcum with 3 per cent. Salicylic Acid and 10 per cent. Boric Acid, in fine powder.

Powders are usually directed to be divided into papers (*chartulæ*); thus, for example, a formula for a prescription would be—

℞. Hydrargyri Chloridi Mitis . . 1.
Sacchari Lactis . . . . . . 9.
Misce cum trituratione et in chartulis No. x. divide.

Encapsuling powders by filling them in gelatin capsules is a very convenient and elegant form of administration. No mixture which is desired to be given in the form of *powder*, however, should be made into a mass for facilitating the encapsuling process—a custom too frequently adopted. Many substances, especially Bismuth Subnitrate and Calomel, become exceedingly hard and quite insoluble when made into a mass. No dispenser should assume the prerogative of changing the form of medication prescribed.

SALES EFFERVESCENTES—EFFERVESCENT SALTS.

These are granulated mixtures of Salts with Sugar and Sodium Bicarbonate and Tartaric Acid, which effervesce when the Salt is dissolved in Water and furnish agreeable aërated draughts.

The following are official, the strength indicated being that contained in 60 grains (4 Gm.), a teaspoonful being the ordinary dose, dissolved in about 6 fluidounces (180 Cc.) of water:

		Gm.	*Gr.*
Caffeina Citras Effervescens	caffeine	0.16	$2\frac{2}{5}$
Lithii Citrata Effervescens	lithium citrate	0.2	3
Magnesii Sulphas Effervescens	magnesium sulphate (average dose 16 Gm. (240 grains), contains 8 Gm. (120 grains) mag. sulph.).		
Potassii Citras Effervescens	potassium citrate	0.8	12
Sodii Phosphas Effervescens	sodium phosphate	0.8	12

Effervescent Salts (Granular) N. F.

The strength given for these is the quantity contained in 90 grains (6 Gm.), which represents about the quantity of these Salts contained in a heaped teaspoonful of ordinary size, the average dose.

FERRI ET QUININÆ CITRAS EFFERVESCENS, 1 grain (0.06) Citrate of Iron and Quinine.

FERRI PHOSPHAS EFFERVESCENS, 2 grains (0.12) Phosphate of Iron.

POTASSII BROMIDUM EFFERVESCENS, 20 grains (1.3) Potassium Bromide.

POTASSII BROMIDUM CUM CAFFEINA, 10 grains (0.6) Potassium Bromide and 1 grain (0.06) Caffeine.

SAL CAROLINUS FACTITIUS EFFERVESCENS (Effervescent Carlsbad Salt, artificial).—A solution of about 87 grains (5.5) in 6 fluidounces (178 Cc.) of Water represents an equal volume of Carlsbad Water (Sprudel).

SAL KISSINGENSIS FACTITIUS EFFERVESCENS (Effervescent Kissingen Salt, artificial).—A solution of about 80 grains (5 Gm.) in 6 fluidounces (178 Cc.) represents an equal volume of Kissingen Water (Rakoczy).

SAL VICHYANUS FACTITIUS EFFERVESCENS (Effervescent Vichy Salt, artificial).—A solution of about 57 grains (4 Gm.) in 6 fluidounces (178 Cc.) of Water represents an equal volume of Vichy Water (Grand Grille).

Salts (Non-effervescent).

SAL CAROLINUS FACTITIUS.—In two forms, Dry (Ph. Ger.) and Crystalline. A solution of about 16 grains (1 Gm.) of the Dry (27 grains (1.8) of the Crystalline) in 6 fluidounces (178 Cc.) of Water represents an equal volume of Carlsbad Water (Sprudel).

SAL KISSINGENSIS FACTITIUS.—A solution of about 24 grains (1.5) in 6 fluidounces (178 Cc.) of Water represents an equal volume of Kissingen Water (Rakoczy).

SAL VICHYANUS FACTITIUS.—A solution of about 14 grains (1 Gm.) in 7 fluidounces (207 Cc.) of Water represents an equal volume of Vichy Water (Grand Grille).

CONFECTIONES—CONFECTIONS.

Confections may be defined as flavored masses wherein the adhesive substance is Sugar in large proportions, serving as a *vehicle* for masking the taste of the drug.

Confections, when made by beating a fresh drug, first reduced to pulp with sugar until of the proper consistence, are termed *conserves*. When made from powders or extracts they are called *electuaries*.

Only one representative of each class is official:

		Gm. in 100 Cc.
Confectio Rosæ . . . . . . (Conserve of Rose)	rose water 16, red rose	8.
	sugar 64, honey	12.
Confectio Sennæ . (*Electuar. Sennæ*)	oil coriander 0.5, senna	10.
	cassia fistula 16, fig 12, tamarind	10.
	prune 7, sugar 55.5, water to	100.

The Confection of Senna is a very agreeable laxative, especially adapted for constipation in women and children. It is exceedingly agreeable to the taste.

TROCHISCI—TROCHES.

Troches, or *lozenges*, are confections made into various forms and then dried.

The vehicle or excipient consists of Powdered Gum Tragacanth or Sugar with flavoring—in some cases orange flower water, in others tolu, nutmeg, vanilla, etc.

The active ingredients are mixed with the diluent or vehicle and made into a plastic mass with the particular excipient, Water or Syrup. The mass is rolled out to the requisite thickness, and the disks formed by cutting through it with a *punch* or troche-cutter. The troches are then dried by exposure.

The size and weight of the troche are regulated by the thickness of the mass and the diameter of the cutter.

The official Troches vary in weight from Gm. 0.5 to 1.5.

		Active Drug.			
Trochisci—		*Gm. in 100 Troches.*	*Gm. in each Troche.*	*Grains in each Troche.*	
Acidi Tannici		6.	0.06	1	Orange flor.
Ammonii Chloridi		10.	0.1	1½	Tolu.
	extract glycyrrhiza	20.	0.20	3⅛	
Cubebæ	oleoresin	2.	0.02	⅓	
	extract glycyrrhiza	25.	0.25	4	
	sassafras oil	1.	0.01	⅙	
Gambir	gambir	6.	0.06	1	Orange flor.
Glycyrrhizæ et Opii					
	ext. glycyrrhiza	15.	0.15	2½	Anise.
	powd. opium	0.5	0.005	1/12	
Krameriæ. . . .	extract	6.	0.06	1	Orange flor.
Potassii Chloratis		15.	0.15	2½	
Santonini		3.	0.3	½	Orange flor.
Sodii Bicarbonatis		18.	0.18	3	Nutmeg.

Lozenges of Peppermint, Lemon, Musk, Vanilla, and Gaultheria may readily be prepared by saturating sugar lozenges with the respective essences or tinctures and permitting the alcohol to volatilize.

MASSÆ—MASSES.

Masses are plastic mixtures of *pilular* consistence. They are made by incorporating the drug with adhesive substances, by chemical reaction, and sometimes by both processes.

The Masses are intended to be formed into pills whenever they are to be dispensed. They are therefore often called Pil., *Pilulæ*, instead of Massa. There are only two official:

Massa Ferri Carbonatis (Vallet's Mass)	sodium carb. 46, ferrous sulph., 100. honey, 38, sugar 25, syrup to 100.

By double decomposition between the Ferrous Sulphate and Sodium Carbonate *ferrous carbonate* is formed, which is incorporated with Honey and Sugar to prevent oxidation and to render the mixture a plastic mass. The Pill of Ferrous Carbonate (Pil Blaudii) is preferable to this mass, as in the pill the ferrous carbonate is better protected against oxidation.

Massa Hydrargyri (Blue Mass)	glycyrrhiza 10, althæa 15, mercury 33. glycerin 9, honey of rose 33.

The mercury is extinguished by trituration with the rose honey and glycerin and the powdered glycyrrhiza; the other ingredients are then incorporated. The usual dose is from 5 to 10 grains (0.3–0.6).

PILULÆ—PILLS.

Pills are spherical, more or less soluble masses of medicinal substances rendered *cohesive*, *plastic*, and *firm* in consistence by the addition of some substance (usually inert) termed an *excipient*.

The *kind* of excipient employed varies with the nature of the medicinal substance. As a general rule, such substances are chosen as give to the mass, with the smallest proportion, the greatest plasticity, and also best preserve the spherical shape of the pills. The excipient must also, unless the contrary be directed for especial purposes, be indifferent in character, to avoid change in the medicinal agents.

Soluble substances are rendered adhesive by the action of sol-

vents, and require, according to their solubilities, the addition of some liquid such as Water, Alcohol, Glycerin, etc. Others require the addition of adhesive substances, such as Syrup, Mucilage, Glucose, Glycerite of Starch or Tragacanth, etc.

Drugs adapted for dispensing in the form of pills may be divided as follows:

(1) The official Masses, Extracts, and Scaled Salts.

Masses and extracts, being of pilular consistence, require no addition except when hard or dry; Water should then be incorporated to restore them to their original form. Powdered extracts are best made into a mass with Water.

(2) Vegetable Powders in which the dose does not exceed five grains.

With these *adhesive* excipients are indicated, such as Syrup, Mucilage, Glycerite of Tragacanth, and Glucose. The last mentioned answers the requirements better than most other substances. Confection of Rose and Extracts of Gentian, Glycyrrhiza, and Taraxacum are also used when their color is not objectionable.

(3) Salts not too deliquescent, and Alkaloids.

Excipients for these must combine *adhesive* and *absorbent* qualities. They are first triturated with a dry powder—*e. g.* Althæa, Glycyrrhiza, or Milk Sugar—and then mixed with the adhesive substance—viz. Glucose or Glycerite of Starch or Tragacanth.

No excipient must be used that will give to the mass a color different from that of the medicinal ingredients (the base).

(4) Volatile Oils and Oleoresins.

The quantity of these when dispensed in pills being comparatively large, it is necessary to add some light *absorbent* substance, such as Magnesia or Starch, to which is added the adhesive material. The practice of adding wax or resin to oils is not to be recommended except as a last resort, since they tend to render the pill insoluble.

(5) Resins and Gum Resins.

These form an adhesive mass by the addition of a little Alcohol, with which more bulky excipients, such as Soap, may be incorporated to preserve the shape of the pill.

(6) Salts of the Cinchona Alkaloids, Quinine and Cinchonidine Sulphates, etc.

These are often prescribed in pill form in large doses, and it is therefore desirable to reduce their bulk. For this purpose dilute Sulphuric Acid or Tartaric Acid is added in small quantity, which acts as a solvent upon the salt, thereby converting it into a mass.

This mass is incorporated with a little Glycerite of Starch, otherwise it soon loses its plasticity; it must therefore be rolled into pills as soon as formed.

(7) Substances easily decomposed by organic matter.

Potassium Permanganate and Silver Nitrate are quickly "reduced" when incorporated with the excipients usually employed.

These should be mixed with an inorganic diluent not affected by them, such as Kaolin, Pipe Clay, or Fullers' Earth, and made into a mass with Water, Petrolatum, etc.

The following Pills are official:

Pilulæ—		Gm. for 100.	In each.		Excipient.
			Gm.	Grains.	
Aloes	aloes purif., soap, each	13	0.13	2	Glyc. water.
Aloes et Ferri	aloes, iron sulph., arom. powder	7	0.07	1	Conf. rose.
Aloes et Mastiches (Dinner Pill)	aloes	13	0.13	2	
	mastic	4	0.04	2/3	
	red rose	3	0.03	1/2	Water.
Aloes et Myrrhæ	aloes	13	0.13	2	
	myrrh	6	0.06	1	
	arom. powder	4	0.04	2/3	Syrup.
Asafœtidæ	asafœtida	20	0.20	3	Soap.
Catharticæ Comp.	ext. colocynth comp.	8	0.08	1 1/3	
	mild mercurous chloride	6	0.06	1	
	extract of jalap	3	0.03	1/2	
	gamboge	1.5	0.015	1/4	Water.
Catharticæ Vegetabiles	ext. colocynth com.	6	0.06	1	
	exts. hyoscyam., jalap, each	3	0.03	1/2	
	ext. leptandra, res. podophyll.	1.5	0.015	1/4	
	oil peppermint	0.8	0.008	1/8	Water.
Ferri Carbonatis (Ferruginous, Chalybeate, Blaud's)	ferrous sulphate	16	0.06	2	
	potass. carb.	8			
	sugar 4; tragac., althea, each	1	. .	. .	Glyc. water.
Ferri Iodidi[1]	reduced iron	4	0.06	1	
	iodine	5			
	glycyrrh., sugar, each	4			
	ext. glycyrrh., acacia, each	1	. .	. .	Water.
Laxativæ Compositæ	aloin	1.3	0.013	1/5	
	strychnine	0.05	0.0005	1/120	Syrup.
	extract of belladonna leaves	0.8	0.008	1/8	
	ipecac	0.4	0.004	1/16	
	glycyrrhiza	4.6	0.046	3/4	
Opii	soap 2; opium pulv.	6.5	0.065	1	Water.
Phosphori[2]	phosphorus	0.06	0.0006	1/100	
	althæa	6	. .	. .	Glyc. water.
	acacia	3			
Podophylli, Belladonnæ et Capsici	resin of podophyllum	1.6	0.016	1/4	Acacia and syrup.
	extract of belladonna leaves	0.8	0.008	1/8	
	capsicum	3.2	0.032	1/2	
Rhei Comp.	rhubarb	13	0.13	2	
	aloes	10	0.10	1 1/2	
	myrrh	6	0.06	1	
	oil peppermint	0.5	. .	. .	Water.

[1] Coated with ethereal solution of Balsam Tolu. [2] Phosphorus dissolved in Chloroform.

In order to disguise the bitter or otherwise disagreeable taste of pills, they are usually coated with sugar or gelatin. These coated pills are often objectionable on account of the coating, or the pill itself, becoming quite insoluble. When a coated pill is desired, it should be freshly made and enclosed in a gelatin capsule of the smallest size. Pills may also be coated extemporaneously by rolling them on a piece of filter-paper saturated with Mucilage of Acacia, and then in powdered Milk Sugar.

Keratin-coated pills are designed for solution in the duodenum, the pills being dipped in a solution of Keratin prepared from horn shavings treated with pepsin and hydrochloric acid. Keratin is insoluble in the acid gastric juice.

Concentric pills are made up of concentric layers of different ingredients, intended to dissolve and become active at various stages in their passage through the intestinal tract.

Unofficial Pills of the National Formulary.

When a large number of pills are to be prepared in accordance with the given proportions, and the quantities of the ingredients are to be determined by multiplying with the number of pills required, it is recommended that the nearest whole number, or nearest convenient fraction, in each case, be chosen.

Pilulæ—

AD PRANDIUM (Dinner Pills).—When "Dinner Pills," under this or some other equivalent name, are prescribed without further specification, the National Formulary recommends that the Pilulæ Aloes et Mastiches of the U. S. P., also called "Lady Webster's Dinner Pills," be dispensed.

Of other combinations bearing similar names or used for similar purposes, the following appear to be those most commonly in use:

Chapman's Dinner Pill.—Aloes, Mastic, each, grains 1½ (0.1); Ipecac, grain 1 (0.06); Oil of Fennel, grain ¼ (0.015).

Cole's Dinner Pill.—Aloes, Mass of Mercury, and Jalap, each, grains 1⅛ (0.075); Ant. and Potas. Tartrate, grain $\frac{1}{50}$ (0.0013).

Hall's Dinner Pill.—Aloes, Ext. of Glycyrrhiza, Soap, and Molasses, each, grain 1 (0.06).

ALOES ET PODOPHYLLI COMPOSITÆ (Janeway's Pills).—Aloes, grain 1 (0.06); Resin Podophyllum, grain ½ (0.03); Ext. Bellad. Alc., Ext. Nux Vomica, each, grain ¼ (0.015).

Pilulæ—

ALOINI COMPOSITÆ.—Aloin, grain, $\frac{1}{2}$ (0.03); Resin Podophyllum, grain $\frac{1}{6}$ (0.01); Ext. Belladonna, grain $\frac{1}{4}$ (0.015).

ALOINI, STRYCHNINÆ ET BELLADONNÆ.—Aloin, grain $\frac{1}{6}$ (0.01 Gm.); Strychnine, alkaloid, grain $\frac{1}{120}$ (0.0005 Gm.); Alcoholic Extract of Belladonna, grain $\frac{1}{8}$ (0.008 Gm.).

ALOINI, STRYCHNINÆ ET BELLADONNÆ COMPOSITÆ.—Aloin, grain $\frac{1}{5}$ (0.012); Ext. Bellad. Alc., grain $\frac{1}{8}$ (0.008 Gm.); Strychnine, alkaloid, grain $\frac{1}{120}$ (0.0005); Ext. Rham. Pursh., grain $\frac{1}{2}$ (0.03).

ANTIDYSPEPTICÆ.—Strychnine, alkaloid, grain $\frac{1}{40}$ (0.0014); Ipecac, Ext. Bellad. Alc., each, grain $\frac{1}{10}$ (0.006); Mass of Mercury, Ext. Colocynth. Comp., each, grains 2 (0.13).

ANTINEURALGICÆ.—1. *Gross' Antineuralgic Pills:* Quinine Sulphate, grains 2 (0.13); Morphine Sulphate, grain $\frac{1}{20}$ (0.003); Strychnine, alkaloid, grain $\frac{1}{30}$ (0.002); Arsenous Acid, grain $\frac{1}{20}$ (0.003); Ex. Aconite Leaves (U. S. P. 1870), grain $\frac{1}{2}$ (0.03).

When "Antineuralgic Pills," or "Neuralgia Pills," without other specifications, are prescribed, it is recommended that the above preparation be dispensed. Sometimes the Morphine is directed to be omitted.

2. *Brown-Séquard's Antineuralgic (or Neuralgia) Pills:* Extracts of Hyoscyamus and Conium, each, grain $\frac{2}{3}$ (0.04); Extracts of Ignatia and Opium, each, grain $\frac{1}{2}$ (0.03); Ext. Aconite Leaves, grain $\frac{1}{3}$ (0.02); Ext. Stramonium, grain $\frac{1}{6}$ (0.01); Ext. Indian Cannabis, grain $\frac{1}{4}$ (0.015); Ext. Bellad. Alc., grain $\frac{1}{6}$ (0.01).

ANTIPERIODICÆ (Warburg's Pills).—1. *With Aloes:* Aqueous Extract of Aloes, grain 1 (0.06); Rhubarb, grain $\frac{1}{2}$ (0.03); Elecampane, Saffron, Fennel, each, grain $\frac{1}{4}$ (0.015); Zedoary, Cubebs, Myrrh, White Agaric, Camphor, each, grain $\frac{1}{8}$ (0.008); Quinine Sulphate, grains $1\frac{2}{5}$ (0.085); Extract of Gentian, a sufficient quantity.

2. *Without Aloes:* The same formula as above, with omission of the Aqueous Extract of Aloes. These pills have been introduced for the purpose of facilitating the administration of Warburg's Tincture in a solid form. When "Warburg's Pills" or "Pills of Warburg's Tincture" are prescribed, without further specification, those containing Aloes are recommended to be dispensed—those without Aloes only when they are expressly demanded.

Pilulæ—

Each Warburg's Pill represents about 1 fluidram (4 Cc.) of Warburg's Tincture. (See *Tinctura Antiperiodica.*)

COLOCYNTHIDIS COMPOSITÆ (Pilulæ Cochia).—Extract of Colocynth, grain $\frac{1}{8}$ (001); Aloes, Resin of Scammony, of each, grains 2 (0.13); Oil of Cloves, min. $\frac{1}{4}$ (0.015).

COLOCYNTHIDIS ET HYOSCYAMI.—Extract of Colocynth, grain $\frac{1}{10}$ (0.006); Aloes, Resin of Scammony, Ext. Hyoscyamus, each, grains $1\frac{1}{2}$ (0.1); Oil of Cloves, min. $\frac{1}{6}$ (0.01).

COLOCYNTHIDIS ET PODOPHYLLI.—Compound Extract of Colocynth, grains $1\frac{1}{2}$ (0.16); Resin of Podophyllum, grain $\frac{1}{4}$ (0.015).

FERRI COMPOSITÆ (U. S. P. 1880).—Myrrh, $1\frac{1}{2}$ grains (0.1); Ferrous Sulphate, Sodium Carbonate, each, $\frac{3}{4}$ grains (0.048).

GALBANI COMPOSITÆ (U. S. P. 1880).—Galbanum, Myrrh, each, $1\frac{1}{2}$ grains (0.1); Asafœtida, $\frac{1}{2}$ grain (0.03).

GLONOINI (Nitroglycerin).—Spirit of Glonoin (1 per cent.), Athæa, each, grains 200 (13.0); Confection of Rose, a sufficient quantity. Make a mass and divide it into two hundred (200) pills. Each pill contains $\frac{1}{100}$ grain (0.0007) of Glonoin (Nitro-glycerin).

LAXATIVÆ POST-PARTUM (Barker's).—Ext. Colocynth. Comp., grains $1\frac{3}{8}$ (0.1); Aloes, grain $\frac{5}{8}$ (0.05); Res. Podoph., Ipecac., each, $\frac{1}{12}$ grain (0.005); Ext. Nux Vomica, $\frac{5}{12}$ grain (0.03); Ext. Hyoscyamus, $1\frac{1}{4}$ grains (0.8).

This is the formula generally employed by Dr. Fordyce Barker, except where special circumstances render modifications necessary. The formula usually quoted in manufacturers' lists and some formularies is not correct.

METALLORUM (Metallorum Amaræ).—Reduced Iron and Quinine Sulphate, each, grain 1 (0.06); Strychnine and Arsenous Acid, of each, grain $\frac{1}{20}$ (0.003).

Aitken's Tonic Pill is a similar combination:

Reduced Iron, grain $\frac{5}{8}$ (0.04); Quinine Sulphate, grain 1 (0.06); Strychnine, Arsenous Acid, each, grain $\frac{1}{50}$ (0.0012).

OPII ET CAMPHORÆ.—Powdered Opium, 1 grain (0.06); Camphor, grains 2 (0.13).

OPII ET PLUMBI.—Powdered Opium and Acetate of Lead, each, grain 1 (0.06).

PODOPHYLLI, BELLADONNÆ ET CAPSICI (Squibb's Podophyllum Pills).—Resin Podophyllum, grain $\frac{1}{4}$ (0.015); Capsicum,

Pilulæ—

grain $\frac{1}{2}$ (0.03); Ext. Bellad. Alc., grain $\frac{1}{8}$ (0.008); Sugar of Milk, grain 1 (0.06); Acacia, Glycerin, and Syrup, each, a sufficient quantity.

QUADRUPLICES (Ferri et Quininæ Compositæ).—Ferrous Sulphate, Quinine Sulphate, Aloes, each, grain 1 (0.06); Ext. Nux Vomica, grain $\frac{1}{4}$ (0.015); Ext. Gentian, sufficient.

TRIPLICES (Triplex).—Aloes, grains 2 (0.13); Resin Podophyllum, grain $\frac{1}{4}$ (0.015); Mass of Mercury, grain 1 (0.06).

When Pilula Triplex, under this name or some equivalent, is prescribed without further specification, the N. F. recommends that the above preparation be dispensed. A formula devised by John W. Francis is also in use:

2. *Francis's Triplex Pill.*—Aloes, Scammony, Mass of Mercury, of each, grain $\frac{5}{6}$ (0.05); Croton Oil, $\frac{1}{20}$ min. (0.003); Oil of Caraway, grain $\frac{1}{4}$ (0.015); Tincture of Aloes and Myrrh, a sufficient quantity.

UNOFFICIAL FORMS OF MIXTURES OF SOLIDS FOR INTERNAL USE.

Granules are small pills, less than 1 grain (0.06) in weight, usually sugar-coated and containing alkaloids and other active drugs.

Parvules are identical with granules. They are usually colored red or pink.

Globules (*Orbiculæ*) are sugar pellets to be saturated with alcoholic solutions of medicinal agents, chiefly in Homœopathy.

Compressed Pills or *Tablets* are made by compressing powders into disks not exceeding 10 grains (0.7) in weight, without any excipient.

Friable Pills are made by aggregation, spreading the powdered mixture upon nuclei or sugar granules in a revolving pan until the pills are formed.

Bolus is the name given to pills exceeding 5–10 grains (0.3–0.6) in weight, used in veterinary practice. A sugar-coated bolus is called a Dragee.

Rotulæ are disk-shaped forms of sugar about $1\frac{1}{2}$ grains (0.1) in weight, which may be flavored with alcoholic solution (spirits).

Bacilli are cylindrical sticks, a form of lozenge (Licorice).

Lamellæ, thin squares of gelatin in which the active agent has been incorporated, intended for solution in the eye.

PREPARATIONS FOR EXTERNAL USE.

To this group belong the *liquid* preparations: Liniments, Oleates and Collodions, and the mixtures of *solids:* Ointments, Cerates, Suppositories, Plasters, and Papers. The Vehicle, sometimes incorrectly called the "base," consists chiefly of fatty substances which serve as protectives or facilitate absorption. The Collodions are, however, an exception.

The solid mixtures may be classified according to their *fusibility*, or melting-points, because their therapeutic uses, as well as their pharmaceutical forms, are through this quality respectively determined.

Ointments fuse at the body-temperature, and therefore produce an emollient effect, or induce *absorption* of the medicinal substance by the system. They are applied by rubbing or inunction.

Cerates have a higher fusing-point, due to Wax they contain; the medicinal agent is not so readily absorbed, and they are therefore used to produce *local* effects, being spread on cloth and applied as *dressings*.

Suppositories fuse slowly when introduced into a body cavity, but maintain their shape at ordinary temperatures. They are for use in rectum, urethra, or vagina.

Plasters have a still higher fusibility; they do not melt, but become *adhesive* by the body-temperature, and are intended to produce *local* effects and afford *mechanical support* to the parts affected.

The fusibilities of these various preparations are likewise governed by the respective vehicles employed.

LINIMENTA—LINIMENTS.

The Liniments are liquid preparations for external use, consisting of solutions of *oily* or *resinous* constituents in Alcohol or Oils, or mixtures of liquid Soaps. The official Liniments are prepared by simple admixture or solution.

Linimentum—

Ammoniæ . . . . cottonseed oil 57; oleic acid 3; ammonia water 35; alchohol 5.

Belladonnæ . . camphor 5 Gm.; fl. ext. belladonna to make 100 Cc.

Calcis (Carron Oil) . . . . . linseed oil 50; lime water 50.

Camphoræ . . . . cottonseed oil 80 Gm.; camphor 20 Gm.

Chloroformi . . . soap liniment 70 Cc.; chloroform 30 Cc.

Linimentum—

Saponis . . . . camphor 4.5 soap 6; rosemary oil 1; alcohol 72.5; water to make 100 Cc.

Saponis Mollis . . . . . . lavender oil 2; soft soap 65 Gm.; alcohol to make 100 Cc.

Terebinthinæ . . resin cerate 65 Gm.; turpentine oil 35 Gm.

Unofficial Liniments of the National Formulary.

Linimentum—

ACONITI ET CHLOROFORMI.—Tincture of Aconite, Chloroform, each, 2 fluidounces (60 Cc.); Soap Liniment, 12 fluidounces (355 Cc.).

AMMONII IODIDI.—Iodine, 30 grains (2.); Oil of Rosemary, Oil of Lavender, each, 110 minims (7 Cc.); Camphor, 220 grains (15.); Water of Ammonia, 1¾ fluidounces (50 Cc.); Alcohol, enough to make 16 fluidounces (473.17 Cc.). On standing, it becomes colorless.

CANTHARIDIS (U. S. P. 1880).—Oil of Turpentine containing 15 per cent. of Cantharides.

IODI (similar to Ph. Br.).—Iodine, 900 grains (60.); Potassium Iodide, 360 grains (24.); Glycerin, ½ fluidounce (15 Cc.); Water, 1 fluidounce (30 Cc.); Alcohol, enough to make 16 fluidounces (473.17 Cc.).

OPII COMPOSITUM (Canada Liniment).—Tincture of Opium, 1½ fluidounces (45 Cc.); Camphor, 120 grains (8.); Alcohol, 4 fluidounces (118 Cc.); Oil of Peppermint, 180 minims (12 Cc.); Water of Ammonia, 6 fluidounces (180 Cc.); Oil of Turpentine, enough to make 16 fluidounces (473.17 Cc.).

PLUMBI SUBACETATIS (U. S. P. 1880).—Solution of Lead Subacetate, 35 parts; Cotton Seed Oil, 65 parts.

SAPONATO-CAMPHORATUM (Opodeldoc; Solid Opodeldoc).—White Castile Soap, 1½ ounces (45.); Camphor, ½ ounce (15.); Alcohol, 20 fluidounces (592 Cc.); Oil of Thyme, 30 minims (2 Cc.); Oil of Rosemary, 60 minims (4 Cc.); Water of Ammonia, Fort., 1 fluidounce (30 Cc.).

TEREBINTHINÆ ACETICUM (Linimentum Album., Stokes' Liniment; St. John Long's Liniment).—Oil of Turpentine, 3 fluidounces (89 Cc.); Fresh Egg, 1; Oil of Lemon, 60 minims (4 Cc.); Acetic Acid, 300 minims (20 Cc.); Rose Water, 2½ fluidounces (75 Cc.).

TIGLII (Linimentum Crotonis, Ph. Br.).—Croton Oil, 2 fluiddrams (8 Cc.); Oil of Cajuput, 7 fluidrams (27.5 Cc.).

Mistura—

TIGLII COMPOSITUM.—Croton Oil, 1 fluidounce (30 Cc.); Oil of Sassafras, 1 fluidounce (30 Cc.); Oil of Turpentine, 1 fluidounce (30 Cc.); Oil of Olive, 2 fluidounces (60 Cc.).

LOTIONES—WASHES.

Lotio—

ADSTRINGENS (Warren's Styptic).—A mixture of Sulphuric Acid, Oil of Turpentine, and Alcohol.

FLAVA (Yellow Wash, Aqua Phagedænica Flava, Ph. Ger.). —Corrosive Mercuric Chloride, 24 grains (1.5), in Lime Water, 16 fluidounces (473 Cc.).

NIGRA (Black Wash; Aqua Phagedænica Nigra, Ph. Ger.). —Mild Mercurous Chloride, 64 grains (4.), in Lime Water, 16 fluidounces (473 Cc.).

PLUMBI ET OPII (Lead-and-Opium Wash).—Lead Acetate, 120 grains (8.); Tincture of Opium, ½ fluidounce (15 Cc.); in Water, 16 fluidounces (473 Cc.). To be shaken when dispensed.

The following are unofficial solutions and mixtures for external use:

Injectio, -ones.—Aqueous solutions for introduction by means of a syringe in the orifices of the body.

Injectio Hypodermica.—Solution for hypodermic or subcutaneous injection.

Enema, -atis; Clyster.—A warm solution of Soap or a mucilaginous mixture for injection in the rectum to produce evacuation, or for nutrition.

Gargarisma, -atis; Gargle.—A wash or lotion for the throat.

Collyrium, -i; "Eye-wash."—A weak solution for instillation in the eyes.

Nebula, -æ; Spray.—A liquid intended for application by means of an atomizer.

Vapor, -oris; Inhalation.—Volatile agents to be added to boiling water and inhaled, to affect the air-passages.

Balneum, -ei; Bath.—Mixture to be added to water for bathing purposes.

OLEATA—OLEATES.

The official Oleates are solutions of oleates in Oleic Acid. They are distinct from the solid oleates, which are made by double decomposition of salts of the metals and alkaline earths and sodium oleate, or Soap. (See *Soap.*)

The *liquid* or *official* Oleates are intended for endermic medication. They are applied by inunction, when the Oleic Acid favors the absorption of the medicinal agent, the oleate in solution. When it is not desirable to administer remedies by the mouth, the Oleates afford an effective form of medication.

The *solid* Oleates are either dry powders, well adapted for protectives as dusting powders, or soft, pliable masses to be applied in the form of ointments or plasters.

Oleatum—

		Percentage by Weight.
ATROPINÆ	atropine	2
COCAINÆ	cocaine	5
HYDRARGYRI	yellow mercuric oxide	25.
QUININÆ	quinine	25.
VERATRINÆ	veratrine	2

Unofficial Oleates of the National Formulary.

The following are simply solutions of the alkaloids in Oleic Acid:

ACONITINÆ.—Contains 2 per cent. of crystallized Aconitine (Duquesnel's).

QUININÆ.—Contains 25 per cent. of Quinine (Alkaloid).

Of the solid Oleates introduced by Dr. J. V. Shoemaker, the following have been recognized, but others may also be prepared as desired:

OLEATUM PLUMBI.—Contains about 28 per cent. of Lead Oxide. It is of the consistence and general character of Lead Plaster, and suggests similar use.

OLEATUM ZINCI.—In the form of a soft white powder, useful as a "dusting powder," or converted into a plaster or ointment by mixing it with such proportion of Oleic Acid as may be required.

OLEA INFUSA—INFUSED OILS.

These preparations are obtained by infusing a dry herb, usually from the so-called narcotic plants, in five times its weight of a mixture of equal parts of Cotton Seed Oil and Lard Oil. *Oleum*

Hyoscyami Infusum is the most familiar example. There are none official.

Oleum—

CARBOLATUM.—A mixture of Cotton Seed Oil with 5 per cent. of Carbolic Acid.

HYOSCYAMI COMPOSITUM (Balsamum Tranquillans).—Infused Oil of Hyoscyamus, with a small proportion of each of the Ethereal Oils of Absinth, Lavender, Rose, Sage, and Thyme.

COLLODIA—COLLODIONS.

The Collodions are solutions in Ether-Alcohol of Pyroxylin or Soluble Gun Cotton. Upon evaporation of the solvent the remaining film excludes the air, thus protecting abraded surfaces. Collodion is also used as a vehicle when a prolonged local effect is desired.

The following forms are official:

		Per cent.
Collodium . .	solution in ether 75; alco. 25; pyroxylin	4
Collodium Flexile . . .	castor oil 3; Canada turpentine	5
Collodium Stypticum	alco. 5; ether 25; acid tan.	20
Collodium Cantharidatum (Blistering Collodion) .	(flex. collo.) cantharides	60

Unofficial Collodions.

Collodium—

IODATUM (Iodized Collodion).—Contains 5 per cent. Iodine in Flexible Collodion.

IODOFORMATUM (Iodoform Collodion).—Contains 5 per cent. Iodoform in Flexible Collodion.

SALICYLATUM COMPOSITUM (Corn Collodion).—Contains 11 per cent. Salicylic Acid and 2 per cent. Ext. Cannabis Indica in Flexible Collodion.

TIGLII (Croton Oil Collodion).—Contains 10 per cent. Croton Oil in Flexible Collodion.

UNGUENTA—OINTMENTS.

Ointments are mixtures of a fatty vehicle with which medicinal agents are incorporated, readily fusing at the body-temperature, 35° to 40° C. (95° to 104° F.).

The medicinal ingredients must be minutely distributed through the vehicle in order that the ointment may not prove irritating, and that the greatest possible surface be presented to the epidermis

with a view to quick and uniform absorption. For this reason the highest quality of an ointment (next to its proper melting-point) is *smoothness*. In the preparation of ointments care must therefore be taken that the method employed be such as to yield *smooth* products.

The melting-point is governed by the fusibility of the vehicle used, which is either officially directed, as in official preparations, or in extemporaneous preparations prescribed by the physician.

The official Ointments are prepared (1) by mechanical admixture, (2) by fusion, or (3) by chemical reaction.

Mixing the medicinal substances with the fatty body in a mortar or on a slab is the process usually employed for solid substances, especially when insoluble in the fat. Powdered drugs, acids, alkaloids, extracts, and salts (not attended by chemical union) are examples adapted to this process.

The following points must be observed:

Solids must be in a fine powder before being incorporated with the vehicle; sometimes it is an advantage to triturate the solid with a small quantity of a bland fixed oil, as Almond Oil or Olive Oil, into a smooth cream before it is mixed with the vehicle proper—Lard, etc.

Extracts should be reduced to a semi-liquid condition by trituration with a little dilute Alcohol or Water. Substances soluble in fats, such as Carbolic Acid, Iodine, and Camphor, may be dissolved directly in the fat by the aid of a gentle heat.

The following are the official Ointments, with their drug-strengths, their respective vehicles being given in parentheses:

Unguentum—		*Percentage of Drugs.*
Acidi Borici	(paraffin and white petrolatum)	10
Acidi Tannici	(glycerin and oint.)	20
Aquæ Rosæ (Cold Cream) . .	spermaceti 12.5; white wax 12; expressed oil of almond	56
	then incorporate borax 0.5; rose water	19
Belladonnæ extract	(dil. alcohol 5; benz. lard and hydrous wool-fat)	10
Chrysarobini (chrysophanic acid)	(benz. lard)	6
Diachylon (Hebra's)	lead plaster	50
	oil lavender 1; olive oil	49
Gallæ	(ointment)	20
Hydrargyri (Mercurial Ointment)	mercury	50
	mercuric oleate 2; suet 23; benz. lard	25

Unguentum—

Hydrargyri Ammoniati . . .	(white petrolatum and hydrous wool-fat)	10
Hydrargyri Dilutum (Blue Ointment)	. mercurial oint.	67
	petrolatum	33
Hydrargyri Nitratis (Citrine Ointment) . . .	mercury	7
	nitric acid 17.5; lard	76
Hydrargyri Oxidi Flavi . . .	(hydrous wool-fat and petrolatum)	10
Hydrargyri Oxidi Rubri . . .	(hydrous wool-fat and petrolatum)	10
Iodi (potass. iod. 4, glycerin benz. lard)	iodine	4
Iodoformi	(lard)	10
Phenolis	(white petrolatum)	3
Picis Liquidæ	yellow wax 15; lard 35; tar	50
Potassii Iodidi .	(pot. carb. 0.6; water 10; benz. lard)	10
Stramonii Extract . . .	(dil. alc. 5; hydrous wool-fat and benz. lard)	10
Sulphuris (washed)	(benz. lard)	15
Veratrinæ (almond oil 6)	(benz. lard)	4
Zinci Oxidi	(benz. lard)	20
Zinci Stearatis	(white petrolatum)	50

Unofficial Ointments of the National Formulary.

Unguentum Acidi Gallici (U. S. P. 1880).—Contains 10 per cent. Gallic Acid.

Unguentum Calaminæ (Unguentum Zinci Carbonatis Impuri; Turner's Cerate).—Contains 17 per cent. Zinc Carbonate (Imp.).

Unguentum Camphoræ (Unguentum Camphoratum).—Contains 20 per cent. Camphor.

Unguentum Fuscum (Unguentum Matris; Mother's Salve). —Contains 50 per cent. of Camphorated Brown Plaster (N. F.).

Unguentum Mezerii (U. S. P. 1880).—Represents 25 per cent. Mezereum.

Unguentum Picis Compositum (Tar, Comp.).—Contains Oil of Tar, 4 per cent.; Tincture of Benzoin, 2 per cent.; and Oxide of Zinc, 3 per cent.

Unguentum Sulphuris Alkalinum (U. S. P. 1880).—Contains 20 per cent. Sulphur and 10 per cent. Potassium Carbonate.

Unguentum Sulphuris Compositum (Wilkinson's Ointment; Hebra's Itch Ointment).—Precipitated Calcium Carbonate, 10; Sublimed Sulphur, Oil of Cade, of each, 15; Soft Soap and Lard, of each, 30 parts. The Lard is mixed with the Soft Soap and Oil of Cade; the Sublimated Sulphur and Precipitated Calcium Carbonate are then gradually incorporated.

CERATA—CERATES.

Cerates are mixtures of fats similar to the ointments, but of firmer consistence, because they contain Wax, Resin, or Paraffin (having a higher melting-point than Lard) in greater proportion than do ointments. In the preparation of Cerates the same rules are to be observed as noted under Ointments.

The six official Cerates are prepared by fusion or simple admixture, and one by extraction and digestion (Ceratum Cantharidis):

		Percentage of Drugs.
Ceratum (Simple) . . .	white petrolatum 20; benz. lard	50
	white wax	30
Camphoræ .	camphor liniment 10; white petrolatum	15
	benz. lard 40; white wax	35
Cantharidis (Blistering Cerate) .	liquid petrolat 15; lard	17
	cantharides	32
	yellow wax, resin, each	18
Plumbi Subacetatis (Goulard's Cerate) . . .	camphor	2
	solution lead subacetate	20
	wool-fat; paraffin; white petrolat.	
Resinæ (Basilicon) . .	yellow wax 15; lard 50; rosin	35
	in cold weather yellow wax 12;	
	lard 53; resin	35
Resinæ Compositum .	rosin 22.5; yellow wax 22.5;	
	suet 30; turpentine 11.5; linseed oil	13.5

Ceratum Camphoræ Compositum, N. F. (Camphor Ice).—Moulded into small cakes suitable for popular use as an application to excoriated surfaces. It contains very small quantities of Benzoic and Carbolic Acids.

SUPPOSITORIA—SUPPOSITORIES.

Suppositories may be defined as variously shaped masses of medicated fat, possessing a consistence ensuring their quick fusion when introduced in the orifices of the body.

The U. S. P. defines Suppositories with reference to their *weights* and *shapes*, corresponding to their several uses—*i. e.* for introduction in the respective orifices of the body—as follows:

Rectal, cone-shaped or spindle-shaped, should weigh 30 grains (2 Gm.).

Urethral, pencil-shaped, should weigh 30 to 60 grains (2–4 Gm.).

Vaginal, globular or oviform, should weigh about 60 grains (4 Gm.).

The vehicle is Cacao Butter (*Oleum Theobromatis*) or Glycerinated Gelatin, both of which possess the property of melting at the temperature of the human body, 35° C. (95° F.), and yet remaining firm at ordinary temperatures. An addition of 10 to 15 per cent. of spermaceti is recommended to raise the melting-point and thus give more stability to suppositories during the heated seasons of the year, or if they contain chloral, phenol, or other substances which soften the vehicle.

The U. S. P. gives a general formula for preparing suppositories; only one Suppository is official, and this is not made from Cacao Butter.

The *methods* of preparing suppositories are quite numerous: any process may be employed by which the product is obtained uniform in size and shape and with the medicinal ingredients thoroughly incorporated. Moulds are usually employed; the medicinal ingredients, if solid, are first reduced to powder in a mortar, and mixed with a small quantity of the grated Fat; the remainder of the Fat, previously melted and cooled to 35° C., is then gradually incorporated with this mixture, thoroughly mixed, and, if possible, without further heating, poured into the moulds, previously chilled.

Another process consists in rolling the mass on a slab, cutting it as in making pills, and forming the cones with the fingers. By cold compression in a screw-press "machine," suppositories may be formed from the prepared mass.

Urethral Suppositories are commonly called *Bougies*, or, more properly, Medicated Bougies. They are usually made with the addition of Wax, or from Glyco-gelatin mass.

Suppositoria Glycerini.—Glycerin 30; sodium carbonate 0.5;

stearic acid 2; water 5. They are made by heating until a solution of *sodium stearate*, or soap, is formed, which is poured into a mould. Upon cooling, the mixture gelatinizes and the suppository is wrapped in tin-foil.

Uses.—Upon introduction into the rectum the mass melts, and the Glycerin, acting upon the feces, produces evacuation.

A formula for suppositories would be:

Extracti Belladonnæ Fol., alc.,	0.1;
Acidi Tannici,	1.0;
Olei Theobromatis, q. s. (20 Gm.).	
Fiant suppositoriæ No. x. (2 Gm.).	

Each suppository would contain $\frac{1}{6}$ grain (0.01) Ext. Belladonna and $1\frac{1}{2}$ grains (0.1) Tannic Acid.

EMPLASTRA—PLASTERS.

Plasters are mixtures of various fatty or resinous solids of such high melting-point as to be friable when cold, but rendered *adhesive* by the warmth of the body.

The *vehicles* of plasters are: Lead plaster; resinous substances, made adhesive by admixture with the medicinal ingredients; and simple plasters, such as isinglass.

The *making* of plasters does not differ materially from the process employed for ointments and cerates, since they are all prepared by melting the various substances and incorporating the medicinal substances last. The *spreading* of plasters, though usually done on a large scale, may be easily effected by the pharmacist with the use of a plaster iron.

The official Plasters may be divided into: (1) Lead Plasters; (2) Pitch and Gum-Resin Plasters; and (3) Isinglass Plasters.

(1) The most important plasters are made from Lead Plaster, or Lead Plaster mixed with Resin, the official Resin Plaster.

Emplastrum—		*Percentage or parts in 100.*
Adhæsivum . .	rubber 2; petrolatum 2; lead plaster	96
Plumbi (Diachylon) . . .	soap 100; lead acetate 60; water q. s.	

From these the following are prepared:

Emplastrum—

Belladonnæ	ext. belladonna leaves	30
	adhesive plaster	70
Capsici	adhesive plaster, 15x15 cm.;	
	oleoresin capsicum	0.25
Hydrargyri	hydrous wool-fat 10; lead plaster 59;	
	mercury oleate 1; mercury	30
Opii	adhesive plaster 90; water; ext. opium	6
Saponis	lead plaster 90; soap	10

Unofficial Plasters of the National Formulary.

Emplastrum—

AMMONIACI (U. S. P. 1880).—Gum-resin Ammoniac with Acetic Acid.

AROMATICUM (Spice Plaster).—Consisting of Cloves, Cinnamon, and Ginger, each, 10 per cent.; Capsicum and Camphor, each, 5 per cent.

ASAFŒTIDÆ (U. S. P. 1880).—Asafœtida 35 p.; Galbanum 15 p.; with Lead Plaster.

FUSCUM CAMPHORATUM (Matris Camphoratum, Ph. Ger.).—Camphorated Mother's Plaster. A plaster similar to lead plaster, and containing camphor, 1 per cent.

GALBANI (U. S. P. 1880).—Galbanum Plaster.

PICIS CANADENSIS (U. S. P. 1880).—Canada Pitch Plaster.

PICIS LIQUIDÆ COMP.—A mixture of Resin and Tar, with Podophyllum, Phytolacca, and Sanguinaria, of each, 10 per cent.

CHARTÆ—PAPERS.

There is one Paper official. It is paper coated with Mustard, used similarly to the Plasters:

Charta Sinapis . . oil-free black mustard, 4 Gm. in 60 sq. cm.

The Mustard is freed from the fixed oil by extraction with Benzin, and mixed with a solution of India Rubber in equal volumes of Benzin and Carbon Disulphide, and spread upon Paper. This is the well-known Mustard Plaster or Mustard Paper. When applied, the paper should be immersed in lukewarm water for a few minutes, in order to render the vesicating principle active.

CHARTA CANTHARIDIS, U. S. P. 1880.—Cantharidis Paper (Blistering Paper).

Poultice or Cataplasm (Lat. *Cataplasma, -atis*).—A coarsely ground substance or mixture of substances, such as flaxseed or elm-bark, made into a mass with hot water or some other liquid, spread upon cloth or filled into porous bags, and applied to the body while hot.

Fomentations (Lat. *Fomentum, -i*).—Porous woollen cloths saturated with hot infusion or decoction of herbs, or other hot liquids or lotions, and applied hot.

Spongiopiline.—A thick cloth covered with layers of sponge for the saturation and retention of medicinal agents intended for absorption, the exterior being composed of waterproof material, such as rubber.

Plaster-Mull.—A thin cloth made impervious with rubber or gutta-percha tissue, upon which is spread or painted medicinal agents in the liquid form, intended for local application.

Caustics or Escharotics (Gr. *Escharotikos*).—Substances used to destroy tissue by chemical action or by heat, either semi-solid mixtures made into a *paste* with starch or other diluent, or chemicals fused and moulded into sticks called *pencils* or "crayons" (Lat. *stilus, -i*), to be applied directly to the skin. *Moxa* is the name given to small cones of combustible substances which upon incineration do not inflame, but give off an intense heat, used for cauterization when heat is desired.

Bandages; Antiseptic Dressings.—The material used for bandages is cellulose in various modifications, such as cotton, linen, jute, and other fibrous substances. Aside from the mechanical support afforded, bandages also serve to keep wounds clean by absorbing and withdrawing secretions (pus) which would otherwise prove irritating, and by protecting them against extraneous matter serve to promote the healing process.

These various substances may be used either plain or medicated, when they are called *antiseptic.*

Gossypium Purificatum, U. S. P.; Absorbent Cotton.—The hairs of the seed of *Gossypium herbaceum* L., freed from oil and resinous substances by treatment with alkalies and bleaching agents. These hairs represent microscopic ducts in which liquids are absorbed through capillarity. The freer from oily constituents, the more readily will watery liquids be taken up and retained; hence, the absorbability of cotton depends upon its purity. This is equally true with all other bandage material.

Linen in the form of thin sheets, known as Muslin or Muslin-

gauze, or purified similarly to cotton, when it is called *Lint*, is made from the bast-fibres of the *Linum usitatissimum* L., Flax. Hemp and Jute are the bast-fibres of their respective plants.

Medicated Dressings.—These are made by saturating the material or vehicle in a solution of certain strength of the medicinal agent, or incorporating the latter in powdered form. In the application of a dressing which has been rendered aseptic or antiseptic by impregnating it with Phenol (Carbolic Acid), Salicylic Acid, Mercuric Chloride, or similar agent, it is desired to bring in contact with the wound a solution of certain strength—for example, a 5 or 10 per cent. solution of Phenol, a $\frac{1}{10}$ or $\frac{1}{20}$ of 1 per cent. solution of Mercuric Chloride, etc. The quantity of material which conveys the agent is of no consequence, as the fabric simply serves as a vehicle for the medicinal or antiseptic agent. The strengths of such dressings should therefore be designated by the *percentage-strength of the solutions by which they are saturated*, rather than by the percentage by weight of the medicinal agent the finished dressing may contain.

In dressings of antiseptic agents that are usually applied in substance, such as Boric Acid and Iodoform, the percentage-amount actually contained by weight in the finished dressing should be stated. Here the use of a vehicle is only a matter of convenience, and it is desirable to know just how much of the medicinal agent is contained in a certain quantity by weight or by area of the dressing.

Medicated Cottons.—Purified cotton is saturated in a solution in Water, or Glycerin and Water, of the strength desired of the medicinal agent, and thoroughly expressed.

The following are the usual strengths:

		Percentage.
Gossypium Boratum	acid boric	5 or 10
Carbolatum	phenol	5 or 10
Iodoformatum	iodoform	10 to 20
Salicylatum	acid salicylic	10 to 20
Stypticum	Monsel's solution	
Sublimatum	mercuric chloride	$\frac{1}{10}$ to $\frac{1}{20}$

Iodoform, being insoluble in Water, should be dissolved in Ether or, preferably, in a mixture of Alcohol and Glycerin.

Medicated Gauzes; Carbasa.—The material used for making Medicated Gauzes is a muslin gauze free from sizing or other extraneous matter. The gauze is thoroughly impregnated with the

solution of the particular strength required, then forcibly expressed, after which it is ready for use; or, if desired for future use, it should be tightly rolled, wrapped in parchment paper, and kept in closely covered boxes in a cool, dry place.

The following are the most commonly used Gauzes and their strengths:

		Percentage.
Carbasus Boratum	acid boric	5–10
Carbolatum	phenol	5–10
Iodoformatum	iodoform	10–20
Salicylatum	acid salicylic	10–20
Sublimatum	mercuric chloride	$\frac{1}{20}$–$\frac{1}{10}$

The Iodoform Gauze is made in the same way as the Cotton, by saturation with a solution of Iodoform in Alcohol and Glycerin. All the others, except the Mercurial Gauze, contain Glycerin. Mercuric Chloride is dissolved in Water with a little Acid Tartaric (5 parts for 1 of Mercuric Chloride), the presence of which in the Gauze prevents the formation of insoluble albuminate of mercury when it is brought in contact with the albuminous discharges from wounds.

Plaster-of-Paris bandages are made by thoroughly incorporating Calcium Sulphate (gypsum) into linen bandages. When applied, the bandage, after being dipped in water, sets hard and firm in a few minutes.

DRUGS WHOSE CHIEF ACTION IS ON THE NERVOUS SYSTEM.

THE ALCOHOLS.

[In the present work care has been taken to designate the proper pronunciation of the names of drugs and their preparations common to Materia Medica and Therapeutics. The simplest and most efficient method appears to be that herein followed—namely, to indicate accent and quantity by a single sign; for example: Alcohol (nom.)—Alcohŏlis (gen.), in which the A is short in the nominative and the accent upon the first syllable, while in the genitive the ŏ is short and the accent is long upon the third syllable.

In nearly all cases the *genitive*, as used in prescription-writing, and the *English equivalent*, are given. When the *accusative*, not genitive, is adopted, the usage is marked by "(acc.)"; as, Pilulæ, Pilulas (acc.), etc.]

A LARGE number of compounds which are derived from members of the marsh-gas series are employed in medicine as depressants of the nervous system, acting more particularly on the higher cortical structures. They are here considered in one general group because of their close similarity in pharmacological action and in therapeutic efficiency. While the fundamental action of these derivatives is on nervous structures, it not infrequently happens that other effects—such as the action of alcohol on the heart, of chloral on muscular tissues, etc.—are of great therapeutic service. Such a consideration brings again into prominence the difficulties of therapeutic classification.

The bodies here under discussion are very numerous. They are derived from various members of the series, and include hydrocarbons, alcohols, ethers, aldehydes, ketones, esters, acids, halogen substitution compounds and their derivatives.

The simplest members of the paraffine group of this series are pentane, C_5H_{12}, hexane, C_6H_{14}, both of which are distilled from petroleum, coming off between 60°–80° C. (140°–176° F.). Their mixture constitutes the well-known PETROLEUM ETHER, or naptha, used so extensively in some anesthetic mixtures; GASOLIN, or benzin, coming off at higher temperature, 80°–120° C. (176°–280° F.), containing heptanes, C_7H_{16}; octanes, C_8H_{18}, has also been used as a general anesthetic.

Of the olefines, or unsaturated hydrocarbons, AMYLENE, C_5H_{10}, and ACETYLENE, C_2H_2, have been used as general anesthetics. They have not proved satisfactory.

The hydroxyl compounds of the saturated hydrocarbons, the *alcohols*, constitute highly important members of the group. The simplest METHYL ALCOHOL, CH_3OH, is widely used in the arts as a solvent, and is frequently drunk as an intoxicant—often with disastrous effects, as will be pointed out; ETHYL ALCOHOL, C_2H_5OH, the next member of the group, is one of the most ancient of reme-

dies and perhaps the most widely used known drug. Its importance in dietetics, in therapeutics, and in toxicology is far-reaching. The higher alcohols, *propyl*, C_3H_7OH, *butyl*, C_4H_9OH, and *amyl*, C_5H_{11}-OH, are frequently found in ordinary alcoholic drinks, and, as *fusel oil*, constitute important poisonous principles.

AMYLENE HYDRATE, dimethyl ethyl carbinol, $(CH_3)_2(C_2H_5)COH$, is a hypnotic of this same series.

The oxides of the hydrocarbons, *ethers*, are represented chiefly by ETHER, diethyl oxide, $(C_2H_5)_2O$, the most widely employed general anesthetic. The æther of the Pharmacopœia contains a small percentage of alcohol, but a new synthetic ether has been introduced commercially and is under investigation. METHYLAL, methylene dimethyl ether, $CH_3OCH_2OCH_3$, and ACETAL, diethyl acetal, $C_2H_5OCHCH_3OC_2H_5$, have also been introduced, as anesthetic and hypnotic respectively. A few compound ethers, *esters*, compounds of an alcohol (or phenol) with an acid are of importance. Most of these bodies by the interposition of the acid molecule are weaker than the ethers of analogous structure. The action of many is unknown. Thus methyl formate (CH_3OCOH) is a constant constituent in crude wood-alcohol and may be one of the factors in its toxic action. Ethyl formate (C_2H_5OCOH) is extensively used in the manufacture of artificial rum and arrack. Amyl acetate ($C_5H_{11}OCOCH_3$) and the allied ethyl butyrate and iso-amyl iso-valerate are widely employed as artificial flavors, pears, pineapple and apples, respectively. Most of the fruit essences are mixtures of these and allied esters.

The addition of alcohol to the nitrous acid radical forms the ester, AMYL NITRITE ($C_5H_{11}ONO$), so widely employed as a vasodilator. In this preparation, however, the NO ions play an important part. The esters formed with carbamic acid, URETHANE, ethyl carbamic ether, $(C_2H_5)CO(NH_2)$, $((OC_2H_5)CO(NH_2))$, and HEDONAL $((C_2H_5)CO(NH_2))$, $((OC_2H_5)CO(NH_2))$, a similar ester with amyl alcohol, have wide applicability as reliable hypnotics. VERONAL, diethyl malonyl urea, $(C(C_2H_5)_2CO(CONH_2)_2)$, is a recent valuable addition to this series.

A number of important *aldehydes* are used: PARALDEHYDE $(C_2H_4O)_3$ is one of the oldest, while within comparatively recent years several sulphur aldehydes have been introduced; SULPHONAL $(CH_3)_2C(SO_2)_2(C_2H_5)_2$, TRIONAL $(CH_3)(C_2H_5)C(SO_2)_2(C_2H_5)_2$, and TETRONAL $(C_2H_5)_2C(SO_2)_2(C_2H_5)_2$ are the most important of these. Sulphonal is the mildest, trional stronger; tetronal is considered almost dangerous.

A number of halogen derivatives have been formed and are valuable. The addition of chlorine, bromine, or iodine to the hydrocarbons have resulted in CHLOROFORM, $CHCl_3$, BROMOFORM, $CHBr_3$, and IODOFORM, CHI_3, the first in wide use as an anesthetic; bromoform as an antispasmodic (still under trial), and iodoform, a valuable antiseptic, showing its alcoholic relationships only in certain forms of poisoning. In these halogen compounds the Cl, Br, and I

ions modify or entirely change the action of the hydrocarbon nucleus. In the case of all of the chlorine synthetics a certain poisoning of the heart muscle seems to accompany the combination. Ethyl compounds are *ethyl chloride*, C_2H_5Cl, a useful general, as well as local, anesthetic, and the closely related *ethylene* and *ethylidine* compounds ($CH_2Cl—CH_2Cl$) and (CH_3CHCl_2), symmetrical and unsymmetrical ethane derivatives, are unsafe. *Methylene chloride*, CH_2Cl_2 has also been used as a general anesthetic. Aldehyde combinations with chlorine are: CHLORAL, CCl_3COH, trichloraldehyde, or more properly chloral hydrate (chloral + water); BUTYL or CROTON CHLORAL (trichlor butyl-aldehyde + water), (($C_3H_4Cl_3$)-CO + H_2O); CHLORALOSE (chloral + glucose); CHLORETONE (chloral + acetone) ($CCl_3(CH_3)_2OH$); CHLORALAMIDE (chloral formamide), ($CCl_3CHOHCONH_2$); URAL, (CCl_3COH) + (OO_2H_5)$CO(NH_2)$, a combination of chloral and urethane; SOMNAL, ural in which another ethyl replaces the OH in chloral. This by no means exhausts the list of these alcohols and their derivatives. Synthetic chemists continue their kaleidoscopic manipulations, and undoubtedly many more useful members of this class will be introduced. The great necessity in the chloral series has been to devise combinations that would have a more agreeable taste than chloral, and further, compounds that would not possess cardiac-depressing effects. For the greater part it would seem that only with the weakest of these had this been accomplished. Efforts have further been directed to the obtaining of a chloral derivative in combination with an analgesic. HYPNAL, a combination of chloral and antipyrine, was such, but it does not seem to have met with favor.

The physiological action of all of the compounds shows a marked qualitative resemblance. With the advance in the series, from lower to higher, until insolubility or non-absorbability militate, they show an increasing quantitative reaction, and from the chemical composition alone a fairly accurate estimate may be made of the grade of this increase in the physiological action. Naturally with the introduction of other active radicals, both qualitative and quantitative variations are introduced.

It has been thought that the action of this group of bodies depends in large part on their special affinity for certain classes of compounds as found in both plants and animals. Disregarding the evidences derived from anesthetization of the leaves of the sensitive *Mimosæ*, etc., the studies of Meyer and Overton seem to represent the best interpretations of the cause of action of these bodies. They have elaborated and confirmed in great detail the belief that it is because of the affinity that these bodies have for lipoids, or fatty substances, that their physiological activities are what they are, and because of the great abundance of these lipoid substances, cholesterin, lecithin, etc., in the nervous structures, there is, as it were, a localized action in these organs, and in a few others rich in fat, the liver (cirrhosis) etc. The ganglion cells of the central nervous system are particularly rich in lipoid substances, and hence

their great affinity for this group of substances. The further evidence of Mann, Vas, Nissl, and others seems to lend some histological foundation to the hypothesis.

It is upon the nervous structures, then, that these bodies act, and the effect is one of gradual poisoning. As may be pointed out later, certain clinical symptoms accompanying the use of members of this series may seem to show irritation and exaltation of function, but even these signs of stimulation are capable of being interpreted in line with the general hypothesis of primary and persistent nerve-cell depression.

The grade of activity of these substances would seem to depend upon the relationship of the affinity of these bodies for water and for oily substances, and physicochemical methods have introduced a series of criteria by which their toxicity, for lower animals at least, might be measured. Thus methyl alcohol is freely soluble in water and dissolves in oil (olive oil being the oil usually used) with great difficulty. Hence its ability freely to enter into the protoplasm is limited, and its toxic action may be inferred to be slight. Amyl alcohol is less freely soluble in water and readily soluble in oils, its coefficient is higher and its toxic power much greater.

Overton has constructed a table showing the results of a series of experiments on plants and lower animals relative to this point.

Ălcohol—Alcohōlis—Alcohol. *U. S. P.*

Definition.—A liquid composed of about 92.3 per cent. by weight, or 94.9 per cent. by volume, of absolute ethyl alcohol, and about 7.7 per cent. by weight of water.

Description and Properties.—A transparent, colorless, mobile, and volatile liquid, of a characteristic, rather agreeable odor, and a burning taste. Miscible with water, ether, or chloroform in all proportions. It is inflammable, and readily volatilized even at low temperatures. Alcohol should be kept in well-closed vessels, in a cool place, remote from lights or fire.

Official Preparation.

Ălcohol Dilūtum—Alcohōlis Dilūti—Diluted Alcohol (U. S. P.).—A liquid composed of about 41.5 per cent. by weight, or about 48.9 per cent. by volume, of absolute ethyl alcohol, and about 58.5 per cent. by weight of water. It should be kept in well-closed vessels, in a cool place, remote from lights or fire.

Ălcohol Absolūtum—Alcohōlis Absolūti—Absolute Alcohol (U. S. P.).—*Definition.*—Ethyl alcohol, containing not more than 1 per cent. by weight of water.

Description and Properties.—A transparent, colorless, mobile, and volatile liquid, of a characteristic, rather agreeable odor, and a burning taste. Very hygroscopic. It should be kept in well-stoppered bottles or tin cans, in a cool place, remote from lights or fire.

Spĭritus Vīni Găllici—Spĭritus Vīni Gălllici—Brandy (U. S. P.).—*Definition.*—An alcoholic liquid obtained by the distillation of the fermented unmodified juice of fresh grapes.

Description and Properties.—A pale amber-colored liquid, having a distinctive odor and taste and a slightly acid reaction. Its specific gravity should not be more than 0.941, nor less than 0.925, corresponding, approximately, to an alcoholic strength of 39 to 47 per cent. by weight, or 46 to 55 per cent. by volume, of absolute alcohol.

Spĭritus Frumĕnti—Spĭritus Frumĕnti—Whisky (U. S. P.).—*Definition.*—An alcoholic liquid obtained by the distillation of the mash of fermented grain, such as Indian corn, rye, wheat, and barley, or their mixtures.

Description and Properties.—An amber-colored liquid, having a distinctive odor and taste and a slightly acid reaction. Its specific gravity should not be more than 0.945 nor less than 0.924, corresponding, approximately, to an alcoholic strength of 37 to 47 per cent. by weight, or 44 to 55 per cent. by volume, of absolute alcohol. Whisky should be at least four years old.

Vīnum Ălbum—Vīni Ălbi—White Wine (U. S. P.).—*Definition.*—An alcoholic liquid made by fermenting the juice of fresh grapes, the fruit of *Vitis vinifera* (nat. ord. *Vitaceæ*), freed from seeds, stems, and skins, and subjected to the usual cellar-treatment for fining and aging.

Description and Properties.—A pale amber-colored or straw-colored liquid, having a pleasant odor, free from yeastiness, and a fruity, agreeable, slightly spirituous taste, without excessive sweetness or acidity. It should contain not less than 7, nor more than 12, per cent. by weight—equivalent to 8.5 to 15 per cent. by volume—of absolute alcohol.

Vīnum Rŭbrum—Vīni Rŭbri—Red Wine (U. S. P.).—*Definition.*—An alcoholic liquid made by fermenting the juice of fresh red-colored grapes, the fruit of *Vitis vinifera* L. (*Vitaceæ*), in the presence of their skins, and subjected to the usual cellar-treatment for fining and aging.

Description and Properties.—A deep-red liquid, having a pleasant odor, free from yeastiness, and a fruity, moderately astringent, pleasant, and slightly acidulous taste, without excessive sweetness or acidity. It should contain not less than 7, nor more than 12, per cent. by weight—equivalent to 8.5 to 15.3 per cent. by volume—of absolute alcohol.

Unofficial Alcoholic Preparations.

Spīritus Rectificātus—Spīritus Rectificāti—Rectified Spirit—contains 85 per cent. by weight of absolute alcohol.

Proof Spirit contains 49 per cent. by weight of absolute alcohol, together with a peculiar volatile oil and other foreign material.

Gin is usually distilled in Holland from rye or barley, and flavored with juniper berries and hops. It contains about 42 per cent. by weight of absolute alcohol, and is probably more diuretic than other liquors because of the oil of juniper it contains.

Rum is obtained by distilling fermented molasses, having about the same alcoholic strength as gin.

Port Wine is prepared by adding spirit during the process of manufacture, bringing the alcoholic strength up to 30 or 40 per cent.

Sherry Wine is a dry wine, having from 20 to 35 per cent. of alcohol.

Sparkling Wines contain from 8 to 10 per cent. of alcohol. They are more or less sweet wines, and are charged with carbonic acid, being bottled before fermentation is completed, the grape-sugar, in consequence, not undergoing conversion into alcohol. The sparkling wines are champagne, hock, and sparkling catawba.

Sweet Wines are those in which the sugar has not all been converted into alcohol, the alcoholic strength being therefore relatively low—from 6 to 7 per cent. Among the sweet wines may be classed Angelica, Madeira, Malaga, Muscatel, Tokay, etc.

Dry Acid Wines are those in which the fermentation is complete, the alcoholic strength varying from 5 to 7 per cent. They are such as California Hock, Ohio and Kelly Island Catawba, Rhine and Moselle wines, Hochheimer, Dürkheimer, Deidesheimer, etc.

Light Red Wines contain 5 to 7 per cent. of alcohol, and are astringent, containing tannic acid and the coloring matter of the grape. They are Claret, Red Rhine, Concord, Hungarian, etc.

Beer, Ale, and **Porter** are prepared by fermenting malted grain with hops and adding other bitters. Beer contains from 2 to 3 per cent. of alcohol; ale and porter, from 4 to 6 per cent., besides carbonic and lactic acids, malt extract, various aromatics, and potassium and sodium salts.

Cordials.—These are mixtures of distilled brandies with high sugar percentage added. The characteristic flavor is derived from volatile oils from the fruits or seeds added to the alcohol mixture before distilling.

Antagonists and Incompatibles.—The motor, cerebral, and cardiac depressants are antagonistic to moderate amounts of alcohol.

Synergists.—The motor excitants, atropin, ether, and the diffusible stimulants.

Physiological Action.—Few drugs have occasioned such diversity of opinion regarding their physiological action and uses as alcohol.

Externally and Locally.—Ethyl alcohol is a distinct bactericide. Applied to the skin it is detergent, bactericide, and extracts water from the skin. When applied in full strength to the skin it produces a sensation of coldness, due to rapid evaporation. Should the drug be diluted, the sensation of cold is greatly diminished. If evaporation be prevented, the effect is that of heat or burning, owing to the penetration of the drug through the epidermis and its chemical influence upon the tissues beneath.

Its effect upon the mucous membranes of the mouth and esophagus is similar in kind to that upon the skin, save that the former are more readily affected. The mucous membrane becomes whitened and corrugated, because of the coagulation of albumin and the abstraction of water. A stimulation of the gastric functions is reflexly due to its local action in the mouth.

Internally.—Digestive System.—Taken into the stomach there is a sensation of heat and marked increase of saliva, due to reflex action; the blood-vessels of the stomach are dilated, with accompanying increase in the secretion of mucus and of the gastric juice. It is not certain whether pepsin is increased in amount or not.

The action on digestion depends largely on the grade of concentration of the alcohol in the gastric contents and upon the individual. In general it may be said that in strengths up to 5 to 10 per cent. the digestive functions of the stomach are improved, although even this degree of concentration may partly destroy the action of the enzymes present. In strengths above 5 to 10 per cent., in some individuals even less, gastric digestion is interfered with. Alcohol increases the muscular activity of the stomach, and aids in the absorption of fluids from the stomach. Immoderate amounts, or the daily and intemperate use of the drug, lessen the flow of gastric juice and increase the secretion of mucus, producing a catarrhal condition.

The action of alcohol on the small intestines is not marked, since most of it is absorbed. When large amounts are taken, as at a large dinner, or during a debauch, diarrhea, in large part due to peristaltic stimulation, is a frequent symptom.

Circulatory System.—Taken into the stomach, alcohol reflexly and rapidly stimulates the heart before absorption can take place, the effect upon the circulation persisting after the drug is absorbed. Cardiac action is rendered more rapid and forcible from small amounts, but it is not certain why. Arterial tension is raised, although the peripheral blood-vessels are dilated, especially those of the skin, owing to the depression of the vaso-constrictors. Toxic doses depress the heart and still further dilate the arterioles, greatly lowering the blood-pressure. This action of alcohol, in causing the heart to beat stronger and faster, at the same time dilating the

blood-vessels—particularly those of the peripheries—renders the drug one of the most valuable diffusible stimulants.

Excessive doses of alcohol greatly depress or paralyze the heart, while an enormous amount, when taken upon an empty stomach, by reflex action occasioning cardiac paralysis, may produce instantaneous collapse. The function of the red corpuscles is impaired, preventing the oxyhemoglobin from parting with its oxygen, consequently retarding oxidation to a slight extent.

Nervous System.—The chief action of alcohol is on the nervous system. All portions of the nervous system are affected at once by the drug, but there seems to be a regular series of poisoning stages with well-recognized clinical signs. Thus it may be said that (*a*) the highest cerebral centers first show the toxic effects; (*b*) the motor-conducting neurons come under the effect of alcohol next; (*c*) the sensory centers then succumb, and (*d*), finally, the medullary centers of respiration and circulation are markedly involved.

In the cerebral cortex the least highly organized of the faculties are primarily modified. The last of the evolutionary developments crumble first. Thus the finer ethical sentiments and regards for the proprieties become abrogated. Judgment becomes affected and bad bargains are made; stupid jokes are thought immoderately funny. Witty sallies are indulged in, which are usually flat.

For certain individuals, particularly in some in whom inhibition is a powerful deterrent to speech and expression (for alcohol cuts off inhibition), and in others from the necessity for stimulus because of antecedent indulgences, alcohol is a powerful cerebral excitant. Under its milder influences such people are often thoroughly aroused and frequently can do their best work. Usually, however, such work, if unrevised, will show, and particularly for the genius of other than the first rank, many intellectual lapses, and it is highly doubtful if alcohol ever induces any real increase in the intellectual powers, save in the certain rare individuals mentioned.

Following or coincidental with the breaking down of the higher intellectual faculties there is a a weakening of the coördinating mechanism of motion. The fiber tracts do not react properly and irregularities of movement, in the lips in speech, in the eyes in winking and seeing (double vision), in the arms in eating or drinking, in the legs in walking, are observed.

Sensory disturbances, anesthesiæ, develop side by side with the other changes. An early loss of tactile impressions is apparent. The drinking man drops his cigar, or his knife or fork. His loss of muscle-sense contributes to his unsteadiness in walking, or in the movements of his arms. A general mild anesthesia contributes to the sense of well-being, since cold, fatigue, slight discomforts are no longer felt; hence one of the great attractions of this class of narcotics for all those who have painful conscious states. It affords an escape from present states of intense consciousness and is eagerly sought after. The urogenital sensory segments are late in sharing in the general anesthesia.

In profound alcoholic narcosis the medullary centers are last seriously involved, the giving out of the respiratory center being the cause of death. Thus impaired consciousness, paresis or paralysis, anesthesia and respiratory failure summarize the march of the toxic action of this drug.

Respiratory System.—Medicinal amounts deepen and accelerate respiration: large doses render the breathing slow and shallow—these effects being due to stimulation or depression of the respiratory center. The stimulation may be secondary rather than primary, due in part to its action on the stomach walls. Death from a toxic dose of alcohol usually results from paralysis of respiration. It may be noted that under toxic dosage of the drug the amount of carbonic acid exhaled is diminished.

Absorption and Elimination.—Alcohol is very rapidly absorbed and circulates in the blood. It is eliminated unchanged in small proportion to the quantity ingested, owing to the fact that the greater proportion of it is oxidized in the body. The kidneys, lungs, skin, and liver share in the excretory process. It is estimated that at least 90 per cent. is oxidized. The products of oxidation are not definitely known, but they are assumed to be acetic acid and CO_2 and H_2O.

Kidneys.—Alcohol increases the amount of urine formed. The causes are partly due to increased blood-flow, a slight increase in pressure, and perhaps some direct action on the epithelium. Single large doses are known to cause albuminuria, and chronic kidney changes are almost universal in chronic alcoholism. Uric acid secretion does not seem to be modified.

Temperature.—Alcohol is an antipyretic of considerable power. This action is owing largely to the cooling of the blood through dilatation of the cutaneous blood-vessels, subjecting the warm blood from the interior of the body to the cooling influence of the atmosphere, and to the cooling of the surface of the body from the evaporation of sweat. The power to resist cold is diminished by the habitual use of alcohol. The drug would be useful in stimulating warmth in a person who had been long exposed to cold, but only in a warm room. Then, by rapidly dilating the blood-vessels of the skin and allowing the blood to flow to the surface, the subject is favorably affected by the external heat, while there is less danger of congestion in some internal organ.

Metabolism.—The action of alcohol in metabolism is intricate. Its many factors have not yet been determined with accuracy. Its rapid absorption and subsequent rapid oxidation brings about an increase in the energy of combustion, and thus alcohol may up to a certain point take the place of certain food elements of the body. Neumann, Atwater, and others have almost conclusively proved that alcohol may be said to save the proteids, and temporarily take the place of carbohydrates and fats as foods. Neumann's classical experiment is worth bearing in mind in this connection. It is known that in the absence of carbohydrates and fats in the diet, the

proteid elements of the body are burned in their place. This is made evident in an increase of nitrogen elimination from the urine; and conversely when surplus quantities of fats and carbohydrates are supplied the nitrogen elimination falls. This general result served as a criterion in a series of experiments in which alcohol was given in the place of fats more particularly and the results on the nitrogen elimination noted. Thus in the experiment referred to a time schedule of thirty-five days, divided in six periods, was followed out. Under a constant diet for five days a nitrogenous equilibrium was first established; then for four days the amount of fat was reduced one-half; this resulted in an immediate and steady increase in the amount of nitrogen eliminated, showing that the proteids were being used to supply the fat deficiency. At the end of this second period alcohol calorically equivalent to the omitted fat was added. After a short period the nitrogen elimination commenced to diminish and at the end of ten days had sunk to the level of the equlibrium line. At this time the full amount of fat, plus the alcohol, was resumed, and the nitrogen elimination became less than before, thus showing that the alcohol had taken the place of a certain amount of fat and spared the proteid. The experiment terminated by a resumption to former conditions when the nitrogen equlibrium was once more attained.

A similar lesson may be learned from the obesity of alcohol users. These accumulate fat because the addition of the alcohol supplies a readily oxidizable substance and the normal fat is not called on for purposes of combustion.

In some particulars alcohol retards certain combustions, interfering at times with the full oxidizing properties of the liver cells, but the precise limits of activity are inadequately known.

In reference to the action of alcohol on the protective agents of the blood-plasma the evidence is inconclusive. It seems fairly well established that continued alcohol-taking reduces the resistance of the body to infections, but it also seems probable that in infectious diseases, for the non-alcoholic, alcohol contributes in some manner to the antitoxic properties of the blood serum. The studies on this subject, however, are far from being conclusive.

Eye.—The excessive use of alcohol may produce amblyopia, watery eyes, and congested conjunctivæ.

Untoward action is fully described under "Poisoning."

Poisoning.—The untoward or poisonous action of alcohol may be divided into what are known as *Acute* and *Chronic Alcoholism.*

Acute Intoxication.—The general physiological phenomena leading up to acute poisoning by alcohol have been discussed, but the clinical picture, while too familiar, may be of service in differential diagnosis. The patient thoroughly under the influence of the drug is lying prostrate, usually in a more or less loose and lax position. His clothing is apt to be much awry and soiled and frequently wet with urine from the diuresis and gradual increase of loss of ability to control the acts of toilet. On inspection the face is found either

flushed and warm in the lighter or early forms of intoxication, or cold and cyanosed in the deep narcoses. The breathing is deep early; or shallow and stertorous later; always in this condition slower than normal (8–10 per minute), in contrast to 5–6 per minute for severe opium poisoning. The pulse may be full and normal in rate, or in the very severe grades small and thin and wiry. The body temperature by rectal thermometric reading is reduced invariably 1 to 2 or even 4° F. The eyes are suffused and bloodshot, the pupils moderately contracted or dilated, depending on the depth of the narcosis. In fatal cases wide dilatation is the rule. The mouth is apt to be moist unless long exposure and stertorous breathing have dried it. An odor of alcohol is present. Too much stress should not be laid on this odor. Mistakes are too often made in the diagnosis between fractured skull and alcoholism because the breath smells of alcohol. Great care must be taken when the two conditions are present. Further examination of the patient will show him difficult or impossible to arouse, and only by pressure on a prominent nerve trunk can a response be obtained. The knee-jerks are abolished, and may be the corneal reflex. Catheterization of the bladder usually reveals a comparatively full bladder, and the urine does not contain any copper-reducing substances—compare with chloral poisoning; diabetes; some skull fractures.

A type of subacute alcohol poisoning is known as *Delirium tremens.* It usually follows a bout of heavy continuous drinking. Its onset may be gradual; or following an *injury*, psychical or physical shock, or even an attack of infectious disease, the train of symptoms may develop very rapidly. Thus in some of this latter type acute delirium tremens may follow immediately after a fracture or during an attack of pneumonia. Sudden grief may also precipitate an attack.

In the gradual cases the early symptoms are those of gradually increasing restlessness; the patient must be up and doing. Wakefulness or insomnia develops and the patient loses his appetite. Muscular tremor of a very fine type, or occasionally muscular twitching or jerking, may be present. There is an increase in all of the patient's reflexes. Irritability is marked, and from the increasing meningeal or cerebral irritation visual and auditory hallucinations begin to develop. At first these are absent in the daytime, and only become bothersome as the patient retires, but later the hallucinations become more marked. They often are representative of the patient's regular occupations; but more classically the visual hallucinations are terrifying in their character—sometimes of the nightmare order—frequently of animals, etc. From this condition, the cerebral irritation progressing, acute maniacal delirium develops. This may end by a fatal collapse.

Chronic alcoholism is generally the result of the continuous and excessive use of alcohol. The symptoms vary according to the individual case. There may be (1) the moderate or immoderate daily drinker; (2) the periodical inebriate. The periodical inebriate,

strictly speaking, is not an inebriate at all, as a rule. There is a widespread distinction between the true periodical inebriate or the dipsomaniac and the inebriate proper. An alcoholic patient becomes insane because he drinks; a dipsomaniac is insane before he commences to drink. Dipsomania may be complicated by alcoholic symptoms, but alcoholism never leads to true dipsomania. Alcoholism is an intoxication having as its cause alcohol, while dipsomania has as its origin a congenital defective condition and alcohol is a secondary factor, which may be replaced by any other intoxicant leaving the syndrome all its psychologic characters. The alcoholic element is a mere manifestation determined at the outset of the attacks.

The habitual drinker sooner or later suffers from disturbed digestion, gastric catarrh, and irregularity of the bowels; his face is usually puffed and bloated, while the capillaries, especially of the cheeks and nose, become permanently dilated, marked acne rosacea not infrequently developing in the latter organ.

The description of types of alcoholic psychoses should be sought for in works on psychiatry. These psychoses are of immense practical importance.

Pathological changes induced by chronic alcoholism are very numerous. Chronic congestion and irritation of the stomach lead to catarrhal gastritis. In the liver new connective tissue forms, particularly in the acini most in contact with the alcohol undergoing combustion. Chronic cirrhosis results with its train of symptoms: ascites, jaundice, biliary infections, etc. Fatty degeneration is common. The circulatory changes are prominent. In beer-drinkers, particularly in those who drink large quantities, there is cardiac dilatation and hypertrophy with degeneration. These patients, usually workers connected with brewing industries, develop the so-called "beer heart." The alcohol, plus the large amounts of water, dilates the stomach; there is irregular and slow, or galloping pulse, with dyspnea and cyanosis.

The continued heart strain leads to myocardial degeneration and to fatty changes. Vessel changes of an arteriosclerotic nature are also present. In the kidneys the vascular changes are the most important factors. These lead to kidney inefficiency, and the irritation or suboxidation to new connective tissue formations, with the development of chronic forms of nephritis.

The nervous tissues are profoundly affected. Changes in the peripheral nerves, nerves of trophic influences, spinal cord, optic nerve, and brain are frequent. In the peripheral nerves a neuritis may develop, leading to isolated paralyses or anesthesiæ, or to multiple neuritis and general peripheral sensory disturbances. Alcoholic paralysis usually affects the extensors, causing wrist-drop and foot-drop, and is, as a rule, accompanied with some sensory disturbances (see Lead Palsy, Arsenical Neuritis). Trophic disorders, herpes, urticaria, ulceration, etc., are not uncommon. In the spinal cord a partial degeneration of the sensory neurons of the posterior

columns leads to a pseudo-tabes, the symptoms closely resembling those of locomotor ataxia. In the eye partial or complete blindness may occur, amblyopia and amaurosis being particularly prevalent following the use of methyl alcohol. Scotomata are common, particularly in reds and greens. In the brain an acute psychosis—delirium tremens—may be set up, or a slow grade of alcoholic dementia supervene.

Treatment of Acute Alcoholic Poisoning.—The stomach should be emptied of all unabsorbed alcohol; cautious inhalations of ammonia should be given, accompanied by the internal administration of black coffee. The patient should be put in warm blankets, made to perspire freely, and if there is great danger of collapse, artificial respiration should be practised and strychnine should be administered. Alcohol derivatives should be avoided.

Treatment of Delirium Tremens.—The management of this phase of alcoholism requires great skill and judgment. The main indications are:

(1) *Elimination.*—By diaphoresis, catharsis, diuresis, warm baths, etc.

(2) *Support.*—Some alcohol may be necessary. Easily digested food. Enemata if necessary.

(3) *Quiet.*—Hypnotics: opium, chloral, bromides.

Treatment of Chronic Alcoholism.—The therapeusis of chronic alcoholism or inebriety turns, like that of any other morbid condition, on the definition of inebriety. In such conditions the relative element is largely involved, not merely as to quantity drunk, but also as to the character of the individual affected. A thoughtful and extended experience with dipsomaniacs will convince most observers that the great majority of them suffer from a disease possessing usually a distinct and traceable etiology, and resulting from either inherited or acquired neurosis. It is a condition akin to epilepsy; the treatment of dipsomania, therefore, turns on the discovery of the conditions preliminary to the drinking period and the determination whether this can be prevented by dietetic and therapeutic methods, as is done in cases of epilepsy.

The medicinal agents most serviceable in the treatment of chronic alcoholism are strychnine, atropine, small doses of the alteratives, arsenic, potassium iodide, and mercury, while phosphorus and other restoratives and tonics will frequently be found useful.

The hygienic surroundings should be of the best, and the treatment should include a nutritious, non-stimulating diet taken with regularity, and the free use of fruits and vegetables. Close attention should be paid to the condition of the bowels and skin, and among other remedial influences should be mentioned laxatives when necessary, balneotherapy, mental and moral treatment, and, above all, change of scene and engaging mental occupation.

Inebriety is so varied in form, so subtle in operation, so intricate in development, and so complex in causation that its treatment is no easy task. Its management, therefore, is management of a pro-

tracted disorder, where any "specific" becomes an absurdity, since the patient, and not the disease, requires treatment.

From time to time various drugs have been heralded as specifics in the treatment of alcoholism, certain "cures" (*sic*) acquiring an influence among the ignorant and unscientific wholly at variance with therapeutic value of these vaunted remedies. It is superfluous to say that for a skilled and enlightened professional judgment the rationale of intemperance and the agents serving to mitigate the malady present a problem far too complicated to be grasped by the empirical understanding, operating even under the most ingenuous motives.

Therapeutics.—*Externally and Locally.*—ALCOHOL is an efficient application for *contusions*, *sprains*, and *indolent ulcers*, and is also serviceable in hardening the skin and preventing the formation of *bed-sores*. It is a useful hemostatic to check *capillary oozing*, and, being a powerful antiseptic, is available in all *wounds*. *Uterine hemorrhage* is controlled by inserting in the cavity of the uterus a tampon saturated with the drug.

Its local anesthetic properties render alcohol valuable in relieving irritation of the skin in *urticaria*, *frost-bite*, etc.; it also serves as an efficient gargle in *diphtheria* and *acute pharyngitis*.

Alcohol is an excellent local application to counteract the caustic action of carbolic acid.

ALCOHOL, or BRANDY, has been successfully employed to *harden nipples* and prevent their cracking.

A very efficient means of reducing *temperature in fever* is to bathe the skin with ALCOHOL, the method being also useful to check *excessive sweating*.

Internally.—ALCOHOL, in the form of WINE, BEER, or ALE, taken before or during meals, is an efficient stomachic. *Atonic dyspepsia* and the *weakened digestion* attendant upon *convalescence from acute diseases* are greatly benefited by some form of alcohol. When digestion becomes impaired as the result of physical or mental exhaustion the drug serves a useful purpose as a tonic. In percentages above 10 per cent. alcohol hinders, rather than aids, digestion. It is obviously contraindicated in gastritis.

The wisdom of using the drug, however, in the conditions mentioned may be questioned, because of the danger of establishing the desire or habit, particularly in the case of neurotic women and those whose debilitated energies call for renewed and increasing quantities of the drug.

Frequently the physical or mental depression, the peculiar, irresistible craving for stimulants, the insomnia and fitful appetite and disposition which urge recourse to alcoholic indulgence, are but the early manifestations of a brain-and-nerve degeneratlon, the impulse to drink being only the physical demand for relief.

There is less danger attending the administration of alcohol in conditions of lowered vitality and weakened digestion in old people than in the young and middle-aged. The drug is decidedly contra-

indicated in persons of average health and fair digestion, although beneficial in the aged, whose powers are failing from natural decline.

The anesthetic and sedative properties of alcohol, especially in the form of CHAMPAGNE, which contains carbon-dioxide gas, may frequently control *obstinate vomiting*. *Gastralgia* and the *pain arising from flatulence* are often readily relieved by BRANDY.

As a pure cardiac stimulant, alcohol is remarkably serviceable in *syncope*, *asphyxia*, *exhausting hemorrhages*, *diphtheria*, and *collapse* where death seems imminent. In counteracting the *effects of narcotic poisons* it is almost indispensable; it is of some service for the treatment of *poisoning by venomous reptiles*, but it is not a specific in any degree.

It is a common practice with some surgeons to precede the inhalation of chloroform with the administration of 1 or 2 ounces (30.0–60.0 Cc.) of WHISKEY or BRANDY, to induce a partial anesthesia before giving the general anesthetic.

In certain stages of various acute diseases, such as *typhoid*, *typhus*, *small-pox*, *pneumonia*, *cerebrospinal meningitis*. *capillary bronchitis*, etc., alcohol is one of the most potent and valuable remedies. It should be employed in these cases only when there is marked depression of the circulatory apparatus, characterized by a weak, rapid, soft, and irregular pulse with a feeble sound of the heart and threatened syncope or delirium.

Alcohol is beneficial in such cases as the foregoing when by its use the tongue is moistened, the pulse and respiration are slowed, the restlessness and delirium quieted, and the skin becomes less parched.

Should the drug increase the pulse rate and intensify the nervous manifestations, it is an indication that the dosage is excessive, in which event it may be well to discontinue the administration altogether. Even where the action of the drug is favorable, it is doubtful whether it should ever be given in fevers throughout the twenty-four hours, administration being advisable rather when the muffled or absent first sound of the heart indicates impending cardiac failure. This usually occurs during the interval between midnight and 7 A. M. Stimulation should therefore begin before midnight, and full doses—say 1 fluidounce (30 Cc.)—be given every three hours, full doses being of more service than repeated smaller amounts.

It should be remembered that alcohol generates no new energy, but simply enables a person to utilize in a short period all his available reserve force. It is, therefore, a remedy for temporary use only, and the utmost discrimination and judgment are requisite to its proper administration.

In *pyemia*, *septicemia*, *erysipelas*, and *diphtheria* alcohol is frequently one of our most efficient remedies. Experience tends to show that tuberculous patients for the most part get along better without alcohol.

Small quantities of alcohol appear to exert a favorable action in *functional impotence.*

Its sedative action, or possibly its property of increasing intracranial blood-pressure, renders alcohol valuable as a hypnotic in mild insomnia, particularly in old people. It may be useful in some cases of insomnia if the patient does not continue to work. It is a very useful hypnotic in the delirium of acute infectious diseases.

The principal therapeutic use for alcohol, perhaps, is as a cardiac stimulant. In syncope, shock particularly, it is invaluable. In acute colds, which are largely local circulatory disturbances, alcohol may restore balance.

Contraindications.—In genito-urinary affections alcohol does more harm than good. It is ordinarily contraindicated in nephritis and diseases of the liver, gout, gleet, gonorrhea, and in urethritis. The malt liquors and sweet wines should not be given in diabetes nor to persons suffering from eczema. Alcohol is also dangerous in hypertrophy of the heart and excessive cardiac action.

Administration.—When possible, alcohol should always be taken with food. Brandy is the best astringent, and brandy and champagne are the best preparations to allay nausea. Whiskey is the least constipating, and gin the most diuretic. As regards their sedative action, there is no preference, whichever is most agreeable to the patient and least affects the head being advisable. As stomachics either claret, beer, or ale is most efficacious in improving the appetite. In cases of fermentative dyspepsia sweet wines and malted liquors are more injurious than beneficial, whiskey or brandy being preferable.

When desired as diffusible stimulants in cases of cardiac failure, brandy or whiskey only should be employed, which preparations may be given hypodermically,

GENERAL ANESTHETICS.

Ether, chloroform, and a number of related compounds, ethyl chloride, methylene chloride, etc., form a group of these alcohol derivatives, in which the property of rapid volatilization causes the formation of vapors which are capable of rapid absorption by the respiratory mucous membrane with the production of general anesthesia. Nitrous oxide causes a similar anesthesia, but its mode of action is very dissimilar.

To Dr. Oliver Wendell Holmes is due the credit of proposing the term "anesthetic." This group occupies a position between the preceding one and the next—Hypnotics.

The use of drugs to abolish pain in surgical operations has probably never been entirely forgotten, but their general and systematic employment only commenced with the use of nitrous oxide by Wells, in 1844, and of ether by his pupil Morton. Shortly afterward a great number of substances were tried by Simpson, with the result that he chose chloroform as being the most convenient and

safe. The power of producing anesthesia, as already pointed out, is common to most of the substances of the fatty or alcohol series. But it is greatly modified by a number of circumstances; the position in the fatty or alcoholic group of the radical or alkyl which forms the basis of the substance, and the nature of the element or radical with which the alkyl is combined, being two prominent ones. Thus in the case of the alkyls, their action differs according as they are combined with hydrogen in the hydrides, with hydroxyl, OH, in the alcohols, or with both oxygen and hydroxyl, as in the acids.

Some members are useful as hypnotics, simply inducing sleep as one of the first results of their action; although if the dose be large, the sleep may pass into complete unconsciousness or anesthesia, with loss of reflex action. For the production of prolonged sleep a substance is required whose action will be slight, and at the same time prolonged; but for anesthesia a substance is needed that will act rapidly and powerfully, but will be quickly eliminated and cease to act very shortly after its administration is discontinued. Hypnotics therefore are found among the substances which have a heavy molecule, and are either liquid or solid in form, so that they may be given by the mouth, and being absorbed into the blood continue to act for a length of time. Anesthetics are found among the lower members of the series which have a light molecular weight, and are either gases or volatile liquids. Although heavy liquids like paraldehyde, or solids like chloral hydrate, will act as anesthetics when given in large doses, yet their use as such would be very dangerous, for the line between their anesthetic action and their paralyzing action on the respiratory center is very narrow and might easily be crossed by a very slight excess in dose.

An ideal anesthetic should be a substance capable of rapidly and safely producing profound anesthesia, and susceptible of speedy elimination, so that consciousness may be restored soon after withdrawal of the anesthetic, with no discomfort to the patient. The typical anesthetic should also be convenient and safe—a stable, non-irritating, pleasantly odorous, homogeneous liquid, with a boiling-point neither too high nor too low. Unfortunately there is no substance which fully meets these requirements, ether and chloroform approaching nearest to the ideal agent.

Local anesthetics are used to deaden the sensation or abolish the sensibility of the peripheral nerves of a localized, particular area. The most important are—cocaine, carbolic acid, iodoform, eugenol-acetamide, antipyrine, orthoform, anesthesin, holocaine, etc. Some aromatics are also quite powerful anesthetics. The physiological action of local anesthetics is given under the respective agents.

Æther—Ætheris—Ether. *U. S. P.*

Origin.—A liquid composed of about 96 per cent. by weight of absolute ether or ethyl oxide, $[(C_2H_5)_2O = 73.52]$, and about 4 per cent. of alcohol containing a little water.

Description and Properties.—A transparent, colorless, mobile liquid, having a characteristic odor and a burning, sweetish taste. Specific gravity, 0.716–0.717 at 25° C. (77° F.). Soluble in about ten times its volume of water, with slight contraction of bulk. Miscible, in all proportions, with alcohol, chloroform, petroleum, benzin, benzene, and fixed and volatile oils.

Ether is highly volatile and inflammable, its vapor, when mixed with air and ignited, exploding violently. It should be kept in well-stoppered containers, preferably in tin cans, in a cool place, remote from lights or fire.

Dose, 15–40 minims (1.0–4.0 Cc.) [15 minims (1 Cc.), U. S. P.].

Official Preparations.

Spiritus Ætheris—Spiritus Ætheris—Spirit of Ether.—*Dose,* ¼–1 fluidrachm (1.0–4.0 Cc.).

Spiritus Ætheris Compositus—Spiritus Ætheris Compositi—Compound Spirit of Ether (HOFFMANN'S ANODYNE).—Ether, 325; alcohol, 650; ethereal oil, 25 parts. *Dose,* 5–60 minims (0.3–4.0 Cc.).

Antagonists and Incompatibles.—The stimulant and anodyne action of ether is antagonized by the arterial sedatives, the tetanizing alkaloids, strychnine, picrotoxin, etc.

Synergists.—The arterial and cerebral stimulants, chloroform and other anesthetics, and alcohol.

Physiological Action.—*Externally and Locally.*—Ether when applied to the skin produces intense cold by its rapid evaporation. If it is confined and its evaporation prevented, great irritation is caused. By spraying a part with ether it becomes quickly frozen, marked local anesthesia being produced thereby.

Applied to mucous membranes, it creates considerable irritation, especially of the fauces and respiratory tract when inhaled.

Internally.—Digestive System.—It is a carminative, increasing peristalsis and the secretions from the pancreas and the salivary and gastric glands, at the same time dilating the vessels of the stomach.

Circulatory System.—When taken into the stomach, ether reflexly stimulates the heart in a manner similar to that of alcohol, raising arterial tension by increasing the force and frequency of the heart's action.

Ether stimulates the heart and increases the blood-pressure when inhaled. It is a diffusible, rapid, and reliable cardiac stimulant.

Respiratory System.—Medicinal doses stimulate and poisonous doses paralyze the respiratory center.

Nervous System.—Ether first occasions a considerable degree of excitement, due to the direct action of the ethyl upon the cerebral cortex. Its action on the cerebrum is similar to that of alcohol, and need not be recapitulated. The action is much more rapid. The stages are all compressed and hence somewhat accentuated. Thus the excitement of the second stage is distinctly comparable with the incoherence and exuberance of the partially intoxicated individual.

Respiration is frequently arrested at the beginning of ether-inhalation, owing to reflex spasm arising from irritation of the peripheral ends of the vagi and trigemini. As the inhalation is

continued the breathing becomes deeper and slower from stimulation of the respiratory center. This part of the nervous system may, in fact, become exhausted from over-stimulation, when the respirations are slow and shallow.

In fatal cases of ether-narcosis the respiration is usually arrested before the cessation of the heart's action.

Absorption and Elimination.—Ether is rapidly eliminated, chiefly by the lungs, but also by the kidneys, which are often considerably irritated by the process.

Temperature.—The prolonged administration of ether produces a great reduction of temperature—doubtless due to the depression of the circulation and respiration and the rapid evaporation of the drug, chilling the body and lungs, rather than to any direct action upon the nervous mechanism presiding over the heat-centers.

In brief, the action of ether when inhaled may be divided into 3 stages for purposes of description. They merge one into another, and in many individuals great variations exist. These may be termed the stage of (1) impaired consciousness, (2) excitement, (3) anesthesia. At first a sensation of choking and irritability of the respiratory mucous membrane is experienced. A greatly increased activity of the salivary glands follows, accompanied by a sensation of pricking or tingling of the hands and feet. The conjunctiva is injected, the face is flushed, the veins of the neck are distended, and there is experienced a peculiar feeling of lightness, together with the beginning of impairment of consciousness. Seeing and hearing are altered, slight insensibility is present, and is sometimes utilized for slight operations. Following this first short period the stage of excitement is usually ushered in by muscular twitchings or muscular struggles. The patient may yell, laugh, cry, curse or pray, struggle or become pugilistic or sometimes amorous. The respirations are usually quickened and irregular from the struggling, and the pulse is rapid and irritable. The pupils are usually dilated.

The stage of anesthesia is usually indicated by muscular relaxation. The patient becomes quiet. The breathing becomes more regular and slower; the heart becomes steadier and slower. The reflexes are abolished, the genital and conjunctival reflexes last involved, and complete anesthesia and unconsciousness with mildly contracted pupils indicate the full action of the anesthetic.

If the inhalation be discontinued before a toxic quantity of ether has been administered, consciousness gradually returns—in some cases almost at once, although some loss of sensation and muscular weakness remain for a while.

The return of consciousness is usually accompanied by retching and vomiting—often by severe rigors, unless care has been taken to keep the patient warm. Great excitement not infrequently attends this stage of etherization.

Treatment of Untoward Manifestations.—Withdraw the ether if there be danger of respiratory or cardiac failure, lowering the head if there be indications of the latter, and if respiratory failure be

threatened, as indicated by cyanosis, avoiding a prostrate position. Meanwhile other measures for the relief of cardiac or respiratory failure may be resorted to: artificial respiration, friction, or the electric current to excite respiratory action, one electrode being placed upon the larynx and the other upon the epigastrium. Hypodermic injections may be resorted to—of strychnine, or atropine, or, in desperate cases, of ammonia. Salt infusion may be used. Adrenalin is useful to restore blood-pressure.

Should nausea become too persistent, a hypodermic injection of morphine will usually suffice to quiet it.

Therapeutics.—*Externally and Locally.*—The local anesthetic properties of ether render it valuable in many diseases of the *skin*, such as *pruritus*, *urticaria*, etc. For treatment of these disorders it is usually combined with some aromatic.

A wet compress saturated with ether has been successfully applied to the forehead for the relief of *epistaxis*. The hypodermic injection of 15 minims (1.1 Cc.) of ETHER in close proximity to the affected nerve has been found valuable in *neuralgia* and *sciatica*.

The hypodermic method of administration has been also practised in the treatment of *shock* and in the threatened collapse following *post-partum hemorrhage*, as well as for the cure of *sebaceous cysts*.

Internally.—ETHER is used as an antispasmodic in order to facilitate certain examinations, the *reduction of dislocations*, and to relieve *pain* in the general practice of surgery, obstetrics, and dentistry. It has been used as an anthelmintic against *tapeworms*.

THE COMPOUND SPIRIT OF ETHER is a stimulant, antispasmodic, and anodyne. It is an efficient remedy for *gastralgia* and *flatulent colic*, and is used to allay many of the symptoms of *hysteria*, as well as *restlessness* and *insomnia* unaccompanied by fever. *Palpitation of the heart* and *nausea* due to the excessive use of tobacco are also greatly benefited by this preparation. In *angina pectoris* and *hiccough* it is an efficient remedy.

Contraindications.—Acute or chronic disease of the kidneys. Dilatation or fatty degeneration of the heart. Subacute bronchitis. Asthma sometimes. Tuberculosis with tendency to hemorrhage. Tumors of the brain or about the neck. Atheromatous condition of the arteries. Enlarged tonsils, chronic alcoholism, or aneurism.

It is necessary at times to give an anesthetic in the foregoing cases, and the surgeon is justified in the use of ether, but the administration should be extremely careful and conducted under skilful supervision whenever the above contraindications exist—particularly in conditions of dilated or fatty heart or chronic alcoholism. Any condition which might prove harmful by reason of the retching and straining, as hernia, etc., sometimes constitutes a contraindication.

Administration.—In administering anesthetics the following precautions should be taken:

The stomach of the patient should contain no food.

The clothing should be loose about the neck, thorax, and abdomen, allowing perfect freedom of respiration.

Artificial teeth should be removed.

It should be remembered that ether is inflammable, and, when its vapor is mixed with air, explosive; it should, therefore, not be used near a flame or an actual cautery, from which it may ignite.

The patient should be kept covered, in order that there may not be too great a reduction in temperature. He should, moreover, be watched for several hours after the administration, since there is always more or less danger until the effects of the ether have entirely disappeared.

Under proper methods the administration of ether occasions little inconvenience. In addition to the recommendations already given, it may be added that smearing the mouth and nose with oil prevents the excoriation frequently occasioned by contact with the anesthetic.

There are various means of administration, the simplest and in many cases the most efficient being a towel shaped into a funnel or hollow cone, with a piece of stiff paper laid between the outer folds to preserve the shape. Many other mechanical contrivances are in use. The Allis inhaler is widely used, although the tendency is to use more complicated inhalers.

In using the towel-cone the inner surface is saturated with about half an ounce of ether, the inhaler at first not being placed close to the mouth and nose, thus allowing the vapor to be sufficiently diluted with air. The effect of this method is to accustom the air-passages to the primary irritation of the anesthetic and graduate its effects. It should be borne in mind that poisoning occurs in both ether and chloroform anesthesias by reason of too concentrated a vapor. Ether should not be administered in more than 6–10 per cent. of vapor. Chloroform vapor should be much more diluted—1–2 per cent. After this the towel may be pressed closer to the mouth and nose and the vapor of ether freely administered. In this manner a person may become completely etherized without nausea or resistance. The insensibility of the conjunctiva and complete relaxation of the muscles, accompanied by semi-stertorous breathing, indicate that the stage of desirable anesthesia is attained. The quantity of ether administered should now be reduced, further supplies being limited to the amount requisite to maintain complete anesthesia.

The symptoms incident to the primary effects of etherization—cerebral excitement, muscular activity, etc.—should not induce withdrawal of the anesthetic, but rather its continuance. Should vomiting occur at this stage, etherization should be suspended and the mouth thoroughly cleansed by means of a sponge or a towel.

Complete loss of consciousness marks the following stage of anesthesia, when total relaxation supervenes, accompanied by gentle, regular breathing. Should stertorous respiration attend further

etherization, it is a warning of paresis, and the drug should be withdrawn.

Congestion of the facial muscles during anesthesia is quite normal, pallor, as a rule, indicating cardiac or respiratory debility. The practice of closely covering the face is thus to be discouraged, since it conceals important symptoms of the patient's physiological condition. The danger from asphyxia in complete etherization is shown by the entire muscular relaxation of the tongue, which is prone to drop backward, and the closing of the glottis, suspending respiration. In such an occurrence the jaw should be pressed forward, the head being well extended, and, if necessary, the tongue brought forward with the forceps.

The pulse, respiration, color, and pupillary reflex are the main points under observation by the anesthetist. At first the rate of the pulse is usually increased by reason of excitement; later it becomes slower and fuller, and when it becomes very slow and feeble, it is wise to ease the patient. The respirations, after the preliminary choking and gagging, become full, deep, and slower. As anesthesia progresses they become shallower and shallower, and should always be watched with a critical eye, especially if cyanosis develops. This indicates the danger-limit to which etherization may proceed. The pupils exhibit a variety of changes and differ in every individual. The usual rule is to have a preliminary dilatation, and during narcosis a moderate state of contraction. If marked dilatation occurs in deep narcosis, this is an indication of poisoning and for the withdrawal of the anesthetic.

Under favorable conditions, from five to twelve minutes are required to etherize the patient completely. The effects of anesthesia upon recovery vary with the temperament and character of the individual and the conditions under which the drug is administered. Great excitability may attend awakening from etherization, or the patient may return to consciousness as from a tranquil slumber. Nausea and vomiting frequently accompany rallying from the narcosis—not, however, such as may require especial treatment. Should somnolence be manifested, it is best not to rouse the patient, that the awakening may be easy and natural.

In etherizing a female patient the presence of a woman is always desirable, in order that her testimony may assuage certain sexual impressions to which women during anesthesia are prone. To the operator and attendants her presence is also of importance.

In collapse states hot applications, the internal administration by hypodermic of caffeine, strychnine, ergot, or adrenalin chloride are each, and may be all, called for. Artificial respiration is imperative; oxygen often helpful, and enteroclysis with hot saline, or infusion may be useful. Suprarenal extracts may be of service.

Great care should be taken to see that the patient is well covered and not exposed to drafts, in its relaxed condition the body being peculiarly susceptible to pneumonia or pleurisy. The anes-

thetic should be carefully examined before administration, and the character of the drug thoroughly known.

Chloroformum—Chloroformi—Chloroform. *U. S. P.*

Definition.—A liquid consisting of from 99 to 99.4 per cent., by weight, of absolute chloroform, and from 0.6 to 1 per cent. of alcohol.

Description and Properties.—A heavy, clear, colorless, mobile, and diffusible liquid, of a characteristic ethereal odor and a burning taste. Specific gravity, not below 1.476. Soluble in about 200 times its volume of cold water, and in all proportions in alcohol, ether, benzene, petroleum benzin, and fixed and volatile oils.

Chloroform is volatile, even at a low temperature, and boils at 60° to 61° C. (140°–141.8° F.). It is not inflammable, but its heated vapor burns, emitting a green flame. It should be kept in dark, amber-colored, glass-stoppered bottles, in a cool and dark place.

Dose, 2–15 minims (0.12–1.0 Cc.) [5 minims (0.3 Cc.), U. S. P.].

Official Preparations.

Aqua Chloroformi—Aquæ Chloroformi—Chloroform Water.—*Dose*, 1–4 fluidrachms (4.0–16.0 Cc.).

Emulsum Chloroformi—Emulsi Chloroformi—Chloroform Emulsion.—*Dose*, 1–4 fluidrachms (4.0–16.0 Cc.).

Linimentum Chloroformi—Linimenti Chloroformi—Chloroform Liniment.—For external use. Chloroform, 30; soap liniment, 70 parts.

Spiritus Chloroformi—Spiritus Chloroformi—Spirit of Chloroform.—*Dose*, 10 minims–1 fluidrachm (0.6–4.0 Cc.).

Antagonists and Incompatibles.—Chloroform will not mix with weak spirits or glycerin. Circulatory and respiratory stimulants and galvanism antagonize to some extent its poisonous action. There is no chemical antidote.

Synergists.—Anesthetics, alcohol, morphine, chloral, and many of the hypnotics.

Physiological Action.—*Externally and Locally.*—Its action is similar to that of ether, though when confined on the skin it produces vesication. It is more of an irritant to mucous membranes than ether, yet when inhaled it is less irritating to the respiratory tract.

Internally.—*Digestive System.*—Its action upon the digestive tract is nearly identical with that of ether, except that when taken in a concentrated form it occasions marked irritation of the stomach and intestines, often resulting in violent gastro-enteritis.

Circulatory System.—Chloroform depresses the heart and circulation, the former by weakening the cardiac muscle, and the latter by lowering arterial pressure by depressing the vaso-motor center. It frequently produces an intermittent pulse by stimulating the inhibitory ganglia of the heart.

Nervous System.—It affects the brain and spinal cord in the same manner and order as ether, like it producing death, usually by respiratory failure, though sometimes the heart first succumbs to the influence of the drug.

Respiratory System.—Its action closely resembles that of ether, though its operation is more rapid and powerful.

Absorption and Elimination.—Chloroform affects the kidneys by

irritation, certain investigators claiming that acute nephritis ensues, blood and albumin being often present; it is certainly less irritating than ether.

Temperature.—It depresses the temperature.

Untoward Action.—If there be any marked idiosyncrasy against chloroform, death has been known to occur suddenly after a few inhalations of the drug.

When applied externally there is produced not infrequently an urticaria-like eruption or an eczematous condition of the skin; vesicles may result. If applied to sensitive portions of the skin, such as the scrotum, severe and persistent pain is sometimes occasioned. Frequently, when applied to wounds and mucous membranes, it causes intense irritation, so much so that the mucous membrane may be shed in pieces.

The symptomatic manifestations of chloroform-anesthesia, the methods of administration, and the treatment of chloroform accidents are in the main similar in general principle to ether, and will be considered only in so far as certain differences are concerned.

The appliances used in producing anesthesia by the aid of chloroform are various, the simplest, as in the administration of ether, being a cone formed of a napkin or a towel enclosing a sponge or not, a sponge alone, or a handkerchief, upon which a small quantity of chloroform—not exceeding from a half to one fluid-drachm (2.0–4.0 Cc.) at a time—is poured. The utmost vigilance is requisite in the administration, the respiration, pulse, and facial indications being constantly observed; a supply of air is allowed to mingle with the anesthetic to obviate the dangerous effect of its concentrated vapor. The drug should be instantly withdrawn upon the slightest indication of untoward symptoms, such as lividity of the face, debility of heart-pulsation, and stertorous or spasmodic respiration, and an ominous dilatation of the pupils.

Although the symptomatic features of chloroform-narcosis, especially those which accompany collapse and death, have been studiously examined, the conditions causing disaster are still but imperfectly understood. Nevertheless, premonitory indications are seldom wanting which mark clearly enough the limit of safety in administration. Of these, extreme mydriasis and failure to produce reflex action in the conjunctiva are alone symptoms to be regarded with the gravest apprehension.

Relative Safety.—Comparisons as to the relative safety of ether and chloroform are misleading. Statistics pointing in both directions have been compiled, and certain surgeons have distinct biases. It would appear that more untoward accidents occur under chloroform-anesthesia than under ether, and a fair estimate may be made of 1 death in 2500–3000 anesthetizations, while for ether observations of numerous surgical services show an average of 1 in 10,000–15,000. Gurlt's statistics on over 300,000 anesthesias resulted in 1 in 2000 for chloroform to 1 in 5000 in ether.

Some Points of Difference in Ether and Chloroform.

Ether.	*Chloroform.*
Not in tropics because of low boiling-point.	Tropics.
Avoid flame.	Not readily ignited.
Large bulk. Army work.	Small bulk. Army work.
Local anesthetic. Cooling.	Not adapted. Irritant.
Irritant to glottis.	Non-irritating. Children. Bronchitis.
Longer time. More excitement.	Shorter time. Less excitement.
Larger quantity. 6 per cent. vapor.	Small amounts. 1 per cent. vapor.
Somewhat safer.	Accidents more liable.
Irritant to kidneys.	Also irritant. Thought to be less.

The comparative value of ether and chloroform may be summarized as follows:

1. If an anesthetic be required, ether is preferable in the case of a patient suffering from a weak cardiac action or an organic disease of the heart.

2. For operations about the face or of the stomach, as there is less danger of reflex inhibition of the heart, ether is preferable to chloroform.

3. Ether is preferable as an anesthetic in the extraction of teeth, chloroform being more apt to cause cardiac paralysis, reflexly by way of the dental nerve to the root of the vagus, and through the vagus to the inhibitory ganglia of the heart-muscle.

4. Ordinarily, ether is superior to and safer than chloroform as an anesthetic for adults unless some special contraindication exists, there being less danger in ether of cardiac failure, to which adults are more liable.

The use of chloroform is more desirable under certain conditions, thus:

1. Obstetrics, since the use of it is attended with less depression and irritation of the respiration and respiratory tract. Moreover, chloroform produces less nausea and vomiting, and may be administered by the patient herself under proper directions.

2. It is preferable in anesthetizing children, being more rapid in its action and less potent as a respiratory depressant, the respiratory center of the child being more susceptible than that of the adult, and in children the danger of cardiac paralysis being slight.

3. Should the patient be suffering from nephritis, chloroform is preferable as an anesthetic, since it is less irritating to the kidneys.

4. Should an anesthetic be required for patients afflicted with pulmonary tuberculosis, empyema, or other disease of the lungs, chloroform should be used, since its effect upon the respiratory system is less depressing.

5. It is preferable in very hot climates, as ether boils at 37° C. (98.6° F.).

Æthylis Chlōridum—Æthylis Chlōridi—Ethyl Chloride. *U. S. P.*

Definition.—A haloid derivative prepared by the action of hydrochloric acid gas upon absolute ethyl alcohol. It is also known as *chelene* or *kelene*.

Description.—A colorless, mobile, very volatile liquid, having a characteristic, rather agreeable odor and a burning taste. It boils at a temperature of 12.5° to 13° C. It is slightly soluble in water, readily in alcohol. It is very inflammable and should not be used in proximity to a gas flame or fire.

A volatile, colorless, and inflammable liquid, having a pleasant odor. It is a very fugacious anesthetic, greatly depressing the heart and respiration, and is mainly used in the form of a spray, to produce local anesthesia. Caution should be observed in operations about the head, as freezing of the cornea is apt to leave residual opacities.

Additional Anesthetics and their Comparative Value.

Ethyl Bromide.—A colorless, inflammable liquid, with a burning taste and an odor like that of chloroform. It is readily decomposed, with evolution of bromide. Its action is uncertain, causing great irritation of the respiratory passages, and usually producing death by paralysis of respiration.

Ethyl Iodide.—A liquid anesthetic, similar in its physiological action to chloroform. Anesthesia produced by it, however, is more tardy, although more permanent. It is considered a comparatively safe and efficient anesthetic to relieve spasm of the respiratory passages, as in asthma and laryngitis.

Ethylene Bichloride.—More rapid and powerful in its action than chloroform, though not so safe, affecting the respiratory center invariably before influencing the heart. While speedier in its action than ether, it is probably more dangerous.

Ethylene Bromide.—A weak yet dangerous anesthetic, greatly depressing the respiratory center, and tending to cause paralysis of the extremities and stoppage of the heart.

Ethylene Iodide.—A crystalline substance, its fumes when heated producing anesthesia, with great irritation of the respiratory passages, and death by asphyxia.

Ethylidene Chloride.—A non-inflammable liquid resembling chloroform in its physical appearance, and in its physiological action as well, although much less depressant to the heart. It causes more irritation to the respiratory passages, with vomiting and great languor and discomfort as its sequelæ.

Methyl Chloride.—A colorless, inflammable gas, with a taste and odor resembling those of ether and chloroform. Cold liquefies it. It is used locally to produce anesthesia and to relieve pain in neuralgia.

Methylene Bichloride.—A colorless liquid, its odor being like that of chloroform. Exposure to the light decomposes it. Anesthesia produced by this agent is accompanied with comparatively little irritation of the respiratory tract, but it occasions a primary

stage of excitement like that induced by ether, and, as in the case of chloroform administration, vomiting is likely to ensue. Death takes place from paralysis of the heart. The numerous fatalities which have occurred under this anesthetic indicate the danger of its use, and its volatility renders its employment difficult in a hot atmosphere.

Carbon Tetrachloride—Tetrachlormethane.—A transparent, colorless liquid, of an agreeable aromatic flavor, analogous in its action to chloroform, but less irritating, although far more dangerous to the heart.

Formic Ether.—A thin, colorless, inflammable liquid, of strong, agreeable odor and pungent taste. It acts like chloroform, though the signs of asphyxia are less marked. Its effects last for several hours.

Methylic Ether.—A colorless, inflammable gas, heavier than air, of an ethereal odor and aromatic taste. Richardson considers it a safe anesthetic, though objectionable because of its odor—less agreeable than those of ether and chloroform—and the rapidity with which it volatilizes from its solution.

Methylal—Methylene—Dimethyl Ether.—A highly volatile, colorless, limpid liquid, of penetrating ethereal odor. It is used chiefly as a local anesthetic and as an efficient hypnotic in insanity and delirium tremens.

Acetic Ether (U. S. P.).—A colorless, limpid, volatile liquid having an agreeable, refreshing, ethereal, and somewhat acetous odor and taste. It has the advantage over sulphuric ether of being less inflammable and less volatile. Owing to its pungent and agreeable odor, too, it is superior to the latter drug in stimulating the nasal passages in cases of syncope and nervous agitation.

Pental.—A colorless, volatile, inflammable liquid, insoluble in water, but miscible in all proportions with alcohol, ether, and chloroform. It has a mustard-like odor, and is comparatively free from danger. When poisonous amounts are administered the pulse is quickened, the respiration embarrassed, and death ensues from paralysis of the heart. It resembles chloroform rather than ether, but is less irritating and seldom accompanied with unpleasant after-effects. It requires but about 5 drachms (20.0 Cc.) to produce anesthesia, which occurs in from two to three minutes.

There is a difference of opinion as to the safety of pental, some physicians considering it less dangerous than chloroform, and others regarding it as less efficient and not so safe.

Nitrous Oxide ("**Laughing Gas**").—A colorless gas, of a very slight, agreeable odor and sweetish taste. It is not inflammable, but supports combustion of ignited bodies. Pressure and cold condense it into either a thin, colorless, very mobile liquid or colorless crystals. It is a rapid anesthetic, unconsciousness being produced in from one-half a minute to three minutes. The pulse is strong and quick, the respirations frequent and shallow, while, as the inhalation continues, the breathing becomes stertorous and the face

is cyanotic. If the inhalation be interrupted or the gas mixed with air, symptoms of intoxication are manifested, accompanied with a high degree of mental excitement. It is a very safe anesthetic, but the anesthesia is of quite short duration, rendering it valuable mainly for the extraction of teeth and in minor surgery.

HYPNOTICS.

The term hypnotics has been applied to a group of substances capable of inducing sleep. A large number of these hypnotics are members of the methane series, or close derivatives. Their hypnotic action is directly comparable with that of alcohol, ether, or chloroform, but, by reason of the addition to the methane radical of different substances, other physiological actions may ensue which may modify to some extent the action of the primary substance.

As already intimated, practically the only alcohol used as a hypnotic is amylene hydrate. Its action resembles that of alcohol, but it induces narcosis more rapidly with smaller doses.

Ămylene Hȳdrate.

A tertiary alcohol, the chemical name being *dimethylethylcarbinol*.

Description and Properties.—It occurs as a limpid, colorless, neutral fluid, of a peculiar odor and burning taste. It is soluble in 8 parts of water, and miscible in all proportions with alcohol, chloroform, benzin, glycerin, and fixed oils.

Dose.—1–2 fluidrachms (4.0–8.0 Cc.).

Therapeutics.—Amylene hydrate is a useful hypnotic, intermediate in strength between paraldehyde and chloral. It is pleasanter to take than either. Many observers consider it to be safer than chloral, while its soporific effects are produced sooner, being manifested usually in from five to thirty minutes, the awakening being ordinarily prompt and complete. Amylene hydrate is best given in a mixture of wine and syrup of liquorice; if administered by rectum, it should be suspended in mucilage.

Of the ethers, other than ethyl ether, *methylal* and *acetal* have both been tried. They have both been found to depress the heart action. Methylal is very rapidly eliminated, and the hypnosis induced is of very short duration. It is given in doses of 8–15 grains (0.5–1.0 Gm.), and is also useful as a carminative.

The esters that have been shown to be serviceable as hypnotics are urethane, hedonal, and veronal.

Æ̆thylis Carbāmas—Æ̆thylis Carbāmatis—Ethyl Carbamate—Urethane. *U. S. P.*

Definition.—An ester of carbamic acid, $CO<^{NH_2}_{OC_2H_5}$, obtained by the reaction of ethyl alcohol upon urea (carbamide) or one of its salts. Reaction: $CO<^{NH_2}_{NH_2} + HOC_2H_5 = CO<^{NH_2}_{OC_2H_5} + NH_3$.

Description and Properties.—It occurs as colorless, odorless, columnar, or tabular crystals, having a pleasant, cooling, and saline taste, somewhat resembling that of saltpetre. It is soluble in about 1 part of water, and in like proportion in ether and chloroform, in 0.6 part of alcohol, 0.8 part of liquefied carbolic acid, 3 parts of glycerin, 15 parts of castor oil, and 20 parts of olive oil.

Dose.—10–45 grains (0.6–3.0 Gm.) [15 grains (1 Gm.), U. S. P.].

Its physiological action resembles others of the alcohol narcotics. The presence of (NH_2) groups prevents an overaction as a hypnotic, and in large doses may even destroy its sleep-producing effects, causing stimulation as in ammonia. It is less depressing upon the circulation and respiration than chloral, but more so upon the peripheral ends of the motor nerves. Acting directly upon the cerebrum, it produces a refreshing and dreamless sleep, with no unpleasant after-effects. Nevertheless, it is not so reliable a hypnotic as chloral, and its usefulness as a therapeutic agent is still a debatable question, probably no hypnotic having been introduced concerning the effects of which there is such diversity of opinion. It may be given in capsules or in some pleasant water or syrup, and may also be conveniently administered as an injection by the rectum.

Hĕdonal.

Methyl-propyl-carbinol urethane, $CO<^{NH_2}_{O\,-}\,CH<^{CH_3}_{C_3H_7}$.

Properties.—A white crystalline powder insoluble in cold water, slightly soluble in warm water. Soluble in alcohol.

Dose.—From 15–45 grains (1–3 Gm.), best given dry on the tongue, washed down, or in a capsule or cachet.

Therapeutics.—A useful hypnotic but not powerful, closely related to ethyl carbamate. Valuable in the insomnia of neurasthenia. It is markedly diuretic and hence may be useful in the insomnia of Bright's disease with diminished secretion. Large doses have been known to cause depression.

Vĕronal.

A related product. Diethyl-malonyl urea, $C(C_2H_5)_2CO(CONH)_2$.

Properties.—A white crystalline powder, soluble in 145 parts of cold water and 12 parts of boiling water. Slightly bitterish taste.

Dose.—8–15 grains (0.5–1 Gm.).

Therapeutics.—A valuable hypnotic of marked action and little after-effects in small doses, save some mild headache. Following large doses, considerable dizziness, and even delirium has been observed. Tolerance does not seem to be readily established. It is valuable in the insomnia of hemorrhage following childbirth, and is useful in mild maniacal excitement. The reports thus far published seem to indicate that it is reliable and safe if given in doses not to exeed 10 or 15 grains (0.6–1 Gm.).

Of the *aldehydes* paraldehyde is the oldest and best known. With the vast accession of new and reliable hypnotics there is little occasion to give this disagreeable substance. It is safe, however.

Sulphonal, trional, and tetronal are three newer hypnotics of this general chemical group. They are sulphons, methane hydrocarbons synthetized with sulphur.

Paraldehȳdum—Paraldehȳdi—Paraldehyde. U. S. P.

Origin.—A polymer of acetaldehyde [$CH_3.COH$].

Description and Properties.—A colorless, transparent liquid, having a strong, characteristic, but not unpleasant, pungent odor, somewhat resembling that of chloroform, and a burning, cooling taste. Soluble in 8 parts of water at 25° C. (77° F.) and in 16.5 parts of hot water, being, as will be observed, more soluble in the former than in the latter. Miscible in all proportions with alcohol, ether, and fixed and volatile oils.

Dose.—¼–1 fluidrachm (1.0–4.0 Cc.) [30 minims (2 Cc.), U. S. P.].

Physiological Action.—*Externally and Locally.*—Antiseptic, antifermentative. In general its action is like that of alcohol.

Internally.—*Digestive System.*—Paraldehyde has little action upon the digestive tract. It may cause indigestion.

Circulatory System.—It differs from chloral in affecting the circulatory system favorably in medicinal doses, tending rather to slow and strengthen the pulse. Toxic doses weaken the heart and lower arterial pressure, the heart's action ceasing in diastole.

Nervous System.—Its influence upon the brain and spinal cord is similar to that of chloral. The sleep it induces, however, is not so prolonged as that caused by the latter drug, more frequent doses being required for continued soporific effects. The sequelæ of paraldehyde are not unpleasant.

Respiratory System.—Its action resembles that of alcohol, although it is not so powerful a respiratory depressant as the halogen derivatives of alcohol. In toxic doses death usually ensues from paralysis of the respiratory center.

Absorption and Elimination.—Paraldehyde is eliminated by the lungs and kidneys, the excretion of nitrogen and phosphorus being somewhat lessened.

Temperature.—Like alcohol, it lowers the temperature, but in less degree.

Untoward Action.—It occasionally causes irritation of the mucous membranes and erythematous eruptions.

Poisoning.—The symptoms of poisoning are similar to those of chloral. Fatty degeneration of the heart and liver have been found, together with disorganization of the red corpuscles.

Treatment of Poisoning.—The same as in poisoning from chloral.

Therapeutics.—Like those of chloral. Paraldehyde is more hypnotic than anodyne, appearing to be best adapted to relieve so-called *idiopathic insomnia.* It is a better diuretic than chloral, and in certain degenerated conditions of the heart and arteries, where a diuretic as well as hypnotic is desirable, paraldehyde serves as a valuable remedy.

Administration.—It may be given in capsules, or, when other-

wise administered, its unpleasant taste may be disguised by giving it in an emulsion flavored with orange or bitter almond. Glycerin also renders it quite palatable, yet it is always more disagreeable to the taste than chloral, besides lending to the breath an offensive and persistent odor.

SULPHUR DERIVATIVES OF ALCOHOL.

In a series of experiments on the feeding of animals with sulphur compounds with reference to the formation of fat, Baumann and Kast found that several of the products caused sleep, and they investigated the whole series of sulphons. Disulphon itself they found inactive, and a large number of the simpler members of the group were found to be inactive because they were not broken up by the body. In those sulphons, however, with a large number of methyl or ethyl groups, they found marked oxidation in the body with a strong hypnotic action. Sulphonal (diethylsulphondimethylmethane), trional (diethylsulphonmethylethylmethane), and tetronal (diethylsulphondiethylmethane) they found were the best of these, and they have been introduced into therapeutics with success.

Sulphonmĕthanum—Sulphonmĕthane—Sulphonal. *U. S. P.*

This substance, diethylsulphondimethylmethane, $\frac{CH_3}{CH_3}>C<\frac{SO_2C_2H_5}{SO_2C_2H_5}$, is the product of the oxidation of the mercaptol obtained by the condensation of acetone with ethylmercaptan.

Description and Properties.—It occurs as colorless, odorless, nearly tasteless prismatic crystals; soluble in 360 parts of cold water, in 15 parts of boiling water, and in 65 parts of cold or 2 parts of boiling alcohol. It is a very stable substance, being unaffected by concentrated acids or alkalies.

Dose.—15–30 grains (1.0–2.0 Gm.) [15 grains (1 Gm.), U. S. P.].

Antagonists and Incompatibles.—There are none of importance.

Synergists.—Morphine and conium intensify its hypnotic action.

Circulatory System.—It has no depressing action on the heart; on the contrary, it slightly accelerates the pulse by depressing the inhibitory center.

Nervous System.—Like chloral, it depresses the cerebral cortex, but has less influence on the motor and sensory nerves. Its soporific action is very much slower than that of chloral, requiring from three to eight hours to produce sleep, which averages about seven hours.

Respiratory System.—In medicinal doses it is much less depressing to the respiratory center than chloral.

Physiological Action.—*Externally and locally,* sulphonal has no influence.

Internally.—Digestive System.—In medicinal doses it has no effect on the digestive tract. Toxic doses may result in nausea, vomiting, and gastric pain.

Its action on the nervous system, on the circulation, and on respiration is like that of alcohol. The sulphon radicals do not seem to enter into the cerebral action to any great extent.

Absorption and Elimination.—Being relatively insoluble, its absorption is slow, usually requiring several hours to exert its hypnotic action. It seems to be broken up in the body, only traces being eliminated unchanged. Traces of methylene and diethylene sulphonic acid appear in the urine. The sulphates of the urine have been said to be increased under its continued use, and in its passage through the blood it exerts a marked action on the red blood-cells, giving rise to a peculiar type of poisoning.

The untoward action and *poisoning* resulting from the use of sulphonal present symptoms of so varied a character that the drug seems to possess no properties of a uniformly toxic nature. Moreover, in the cases of poisoning recorded the condition of the patient and the quality of the drug have been such as to require considerable variation in the amount given. In one case 30 grains (2.0 Gm.) produced death in forty hours (*Med. News*, lv., p. 166); while in another a man swallowed 3 ounces (96.0 Gm., of sulphonal, which, although resulting in a condition of coma lasting six days, terminated in recovery (*Jour. Amer. Med. Assn.*, iv., p. 21).

In general, however, the poisonous effects of sulphonal are exerted on the blood and on the nervous system. When large doses are taken unconsciousness, which may persist for long intervals, is the most prominent symptom. Paralyses, but rarely convulsions, have been noted. Respiration is at first unaltered, but later may become stertorous, shallow, and slow. Cyanosis develops; the pulse is small and irregular. A preliminary fall of temperature is followed by a rise, perhaps to 40 C. (104 F.). The kidneys may or may not be affected. There may be constipation, or, if paralysis of the intestinal musculature has occurred, a diarrhea may supervene. Papular exanthemata are not uncommon.

In individuals who may be taking any of this type of hypnotics for any considerable period of time irregular toxic symptoms are noted. These consist for the most part of hebetude, sleepiness, stupidity, loss of appetite, and muscular weakness; the frequency of the pulse is diminished, and if the poisoning is more pronounced, there may be dizziness, ataxia, and, rarely, hallucinations and delirium. The most important symptom is the presence of hematoporphyrinuria, produced by the breaking up of the blood-pigment in the red corpuscles and its appearance in the urine as hematoporphyrin, a reduction product of hemoglobin. This gives this fluid a peculiar cherry-red color. Its appearance is a signal to cease the use of the drug.

Of the three drugs of this class, trional is perhaps to be preferred. Tetronal is not to be recommended. Very persistent habits may be contracted by takers of these drugs.

Treatment of Poisoning.—Discontinuance of the drug; eliminative and symptomatic treatment.

Therapeutics.—Sulphonal is never used *externally*, and *internally* it is chiefly valuable as a hypnotic—in insomnia unaccompanied by pain, and particularly to produce sleep and quiet the intense *excitement of the insane.* When insomnia is accompanied by considerable motor restlessness, combinations of sulphonal, of trional, or of veronal with old vegetable narcotics, like hyoscyamus, conium, etc., are frequently beneficial to produce sleep and quiet the motor disturbance. The following is an excellent formula:

℞. Sulphonal,	gr. xviij (1.12 Cc.);
Fluidextracti conii,	♏xviij (1.12 Gm.).
Ft. caps. No. VI.	

Sig. Take two at 6 P. M., two at 8 P. M., and two at 10 P. M. The next night half this quantity will probably suffice.

The author has used this prescription with good results in *hiccough* and *noctural cramps.* It should prove efficacious in other spasmodic affections, such as *chorea, epilepsy,* and the *spasm of fractures.* Sulphonal has been recommended as a sexual sedative in *chordee* and *spermatorrhea,* and as a useful remedy in colliquative *night-sweats.* When used for a long time, it has a deleterious action on the heart, and should not be employed in cases of insomnia from cardiac disease.

Sulphonal is of no value in insomnia due to pain.

Wood recommends the drug as an intestinal antiseptic when given an hour after meals.

Administration.—Sulphonal should be given in powder or capsules or in hot whiskey. Owing to its insolubility, it should not be administered in the form of compressed tablets.

Sulphonethylmethanum — Sulphonethylmethane — Trional. *U. S. P.*

Diethylsulphonmethylethylmethane, $(CH_3)(C_2H_5)C(SO_2C_2H_5)_2$, a product of the oxidation of mercaptol, obtained by the condensation of methylethylketone with ethylmercaptan.

Description.—It occurs in colorless, lustrous, odorless, crystalline scales which have a bitter taste in aqueous solution. Trional is soluble in 195 parts of water, more readily in boiling water, and readily soluble in alcohol and ether. It melts at 76° C.; hence if a test-tube containing some of the powder be placed in hot water, the substance will melt; sulphonmethanum sulphonal (the melting-point of which is 125.5° C.) will not melt under these circumstances.

Dose.—Average dose, 15 grains (1 Gm.), U. S. P.

Therapeutics.—By reason of its greater solubility its action is more rapid than that of sulphonal. Identical symptoms of poisoning as those of sulphonal have been noted, but breaking down more rapidly and being eliminated much faster, the tendency to cumulative action and to blood-destruction seems less than with its ally sulphonal. In combination they are useful hypnotics.

Tetronal (Diethyl-sulphon-diethyl-methane).—*Origin.*—This substance is also prepared like sulphonal.

Description and Properties.—Colorless, shining plates and laminæ, of bitter taste and slightly camphoraceous odor; soluble in 450 parts of cold and in 5 parts of boiling alcohol; insoluble in water.

Dose.—10–40 grains (0.6–2.5 Gm.).

Therapeutics.—Tetronal seems to be more poisonous than either of the others of the group. Why this should be so is not yet established. Like sulphonal, however, it breaks down slowly, and a cumulative action may account for its greater toxicity.

HALOGEN DERIVATIVES OF ALCOHOL.

A large and important series of hypnotics are classed in this group. Chloral, the point of departure of the others, has been in use for a number of years, and in the attempt to produce a similar body free from the disagreeable taste and from some of the more depressing cardiac action, a host of alcohol halogens has been made and introduced into therapeutics.

The introduction of chlorine into the hydrocarbon series produces a more marked change in the action than has been noted for many of the alcoholic derivatives already discussed.

Ordinary marsh gas, CH_4, has a very slight narcotic action. CH_3Cl is stronger, CH_2Cl_2 still stronger, $CHCl_3$ (chloroform) very active, and CCl_4 very highly toxic. A gradual increase in toxicity has been observed with the addition of chlorine atoms. In the same manner aldehyde is a mild narcotic, trichloraldehyde much more powerful. A large number of these compounds have been employed in anesthesia; these have already been discussed.

For the most part the newer chloral substitutes are known to break down into chloral in the metabolism of the body. On general principles, therefore, it is difficult to see wherein they are to offer any marked advantages over the parent body itself. If, however, the compound with which it is combined is so split off in the body and is then so unmodified as to be active and to be able to overcome the untoward effects of the chloral or its reduction compounds, a useful hypnotic must be the result. Up to the present time it does not appear from other sources than those with a commercial bias that this very desirable combination has been found. There is no reason to believe that it may not be accomplished, but nearly all the theoretically possible combinations have been made and tried. A number of the compounds now manufactured are useful nevertheless, and will be here considered.

Chlorālum Hydrātum—Chlorāli Hydrāti—Hydrated Chloral. *U. S. P.*

Definition.—A crystalline solid composed of trichloraldehyde or chloral [$CCl_3.COH$] (an unstable, oily, and colorless fluid), with 1 molecule of water, forming the *Hydrate of Chloral*, the official preparation, and the only one used in medicine. Chloral itself is prepared by the action of chlorine upon alcohol, whence the name *chlor-al*.

Description and Properties.—Chloral hydrate occurs as separate, rhomboidal, colorless, transparent crystals, having an aromatic, penetrating, and slightly acrid odor, and a bitterish, caustic taste. It is slightly volatilized when exposed to the air, and is freely soluble in water, alcohol, and ether, being also soluble in chloroform, benzol, benzin, carbon disulphide, and fixed and volatile oils. It liquefies when triturated with an equal quantity of camphor, menthol, thymol, or phenol.

Dose.—5–20 grains (0.3–1.2 Gm.) [1 Gm.–15 gr., U. S. P.].

Antagonists and Incompatibles.—Chloral is incompatible with all alkalies, and calcic hydrate converts it into formate of calcium and chloroform. Strychnine, atropine, and external heat are antagonistic.

Synergists.—All the hypnotics favor its characteristic property of producing sleep. Morphine enhances its hypnotic effects, while lessening its depressing influence upon the heart.

Physiological Action.—*Externally and Locally.*—Chloral is germicidal, antiseptic, anesthetic, and vesicant. It produces redness and sometimes vesication when applied to the unbroken skin, and when strong solutions are brought in contact with the derma or with wounds they may even occasion sloughing, and in healthy mucous membranes excite much pain. When introduced into the system hypodermically, chloral is apt to occasion gangrenous inflammation.

Internally.—Digestive System.—Small doses are slightly sedative to the stomach, though causing a sense of burning in the throat and exciting more or less salivation. Large doses sometimes produce nausea, vomiting, and purging. The pancreatic and biliary secretions are probably slightly increased.

Circulatory System.—Full medicinal doses may at first accelerate the pulse, which soon, however, becomes slower, weaker, and softer. Under toxic doses the heart's action may be weak, rapid, and irregular, when death ensues, the heart being arrested in diastole.

A primary effect of chloral is to lower arterial tension by its depressant action upon the heart through its nervous mechanism. It acts similarly upon the vasomotor center and upon the structures in the arteriole wall, dilating the blood-vessels.

In its depressing action on the heart chloral is more pronounced than in other non-chlorinated members of the alcohol group. It is highly probable that the presence of chlorine is an important factor in this added toxic action in the circulation.

Nervous System.—Medicinal doses sometimes occasion a preliminary stage of cerebral excitement, due probably to a temporary stimulation of the circulation and possibly transitory cortical irritation. This is soon followed—usually in from fifteen to thirty minutes—by a sound, dreamless slumber, induced by a direct depression of the cortical cells of the brain. The sleep thus produced closely resembles that of physiological slumber. It usually persists for from seven to eight hours, when the patient awakes refreshed and usually without *malaise* or digestive disturbance.

The action on the spinal cord is one of depression, as in alcohol. The actions on the special senses resemble those of chloroform.

Respiratory System.—In full doses chloral is a respiratory depressant, rendering the breathing slower and weaker, while under toxic doses it may cease altogether from paralysis of the respiratory center.

Absorption and Elimination.—Chloral is quite rapidly absorbed, and is supposed to circulate in the blood in its original state. It is

eliminated by the lungs and skin, but chiefly by the kidneys, where it reappears as urochloralic acid, which consists of trichlorethyl alcohol combined with glycuronic acid, although when an excessive amount of the drug has been taken it may be found in the urine unchanged. It usually increases the flow of urine, and reduces Fehling's solution. The presence of chloral derivatives should, therefore, always be thought of in testing for sugar.

Metabolism.—Chloral behaves in large part as chloroform on metabolism. It leads to increased proteid destruction and lessens cellular oxidative functions. It thus shows increased phosphates, nitrates, and sulphur, and by the suboxidations leads as from alcohol, to fatty degenerations. The diminution in muscular activity retards muscle metabolism, thus less oxygen is observed and less carbon dioxide is excreted. In large doses chloral exerts a destructive influence on the blood and also in blood-vessels.

Temperature.—Chloral is a decided antipyretic even in medicinal doses, while toxic doses produce a dangerous reduction of temperature. This action is doubtless owing to a diminution of heat-production because of diminished oxidation in the cells of the body and to an increase of heat-dissipation from the dilated cutaneous vessels.

Eye.—The continued use of chloral almost invariably results in a contracted pupil, unless psychic alterations supervene, when the pupillary contraction gives place to dilatation.

Untoward Action.—There may occur great anxiety; disturbances of respiration, such as spasmodic breathing and even asphyxia, together with disturbances of vision and swelling of the conjunctivæ. There may also be present edema of the epiglottis, icterus, and various cutaneous eruptions commonly designated as "chloral rash."

Poisoning.—Although one of the most powerful hypnotics known, extraordinary doses of chloral have failed to prove fatal, as many as 460 grains (30 Gm.) having been given without serious poisoning. Nevertheless, 10 grains (1.6 Gm.), an ordinary dose, has been followed by toxic effects, while 15 grains (1.0 Gm.) has produced death. In view of so uncertain a power, great care is requisite in the administration of this drug.

Acute Poisoning.—The symptoms of poisoning from lethal doses are those of profound alcoholic narcosis plus the specific chlorine action. The patient is comatose. The pulse is feeble, thready, and irregular; the temperature is below normal; respiration is slow; the skin, particularly that of the forehead and extremities, may be covered with cold sweat and is pallid or cyanotic; the pupil is moderately contracted. There is great muscular relaxation, together with abolition of reflexes. Death is caused by paralysis of the respiratory center with pronounced cardiac weakness.

Autopsies have revealed inflammation of the mucosa of the mouth, esophagus, and stomach. In the latter organ ecchymoses may be present. Blood-changes are not constant but agglutina-

tion of the red blood-cells occur, and hyaline thromboses are present. Beginning fatty degeneration is also present in many of the organs, particularly the liver and kidneys.

Treatment of Poisoning.—It is of primary importance to maintain or restore the temperature by means of artificial heat—warm blankets, hot bottles, friction, massage, or other resources at command.

In order to arrest respiratory failure and stimulate the circulation, hypodermic injections of strychnine or atropine or the administration of other physiological antidotes, the inhalation of oxygen, and artificial respiration, may prove advantageous. Coffee as a hot rectal infusion is of value, and intravenous salt infusion may be demanded in severe cases. Naturally all alcoholic forms of stimulation are to be avoided.

Chronic Poisoning.—Chloral toxemia, or chloralism, is a well-recognized development of simple dosage.

The skin as in alcoholism may be subject to erythematous eruption, either persistent or temporarily excited by trivial causes. Respiration is embarrassed by the presence of dyspnea, which, however slight, is manifested after meals or is stimulated by physical exertion. Finally, the gravest complications may occur in the circulatory system, resulting in high fever, pyemia, and ultimate collapse.

The simplest treatment in these extreme cases is primarily the gradual withdrawal of the toxic agent, although delirium tremens is recorded as a result of abstention. The diet should be carefully regulated with a view to restoring, if possible, the decreased vitality. Change of scene, abundant air and exercise, chalybeate tonics, calmatives, and nerve-stimulants undoubtedly contribute to re-establish functional activity and normal circulation, and occasional purgatives may assist in eliminating from the body the toxic elements which the pathological cells are constantly forming.

Therapeutics.—*Externally and Locally.*—An injection of a 10 per cent. solution of CHLORAL into the sac has been highly recommended by Marc Sée in the treatment of *hydrocele*. One ounce of this solution is injected, being followed in two or three days by a copious effusion, which is soon absorbed.

The antiseptic properties of chloral are utilized as a wash or dressing in *cancer of the uterus, foul ulcers*, etc. For these purposes the strength should be from 5 to 10 grains (0.3 to 0.6 Gm.) to 1 ounce (30.0 Cc.).

Spohn recommends the continued application of a solution of 1 drachm (4.0 Gm.) of chloral in 4 drachms (16.0 Cc.), each, of glycerin and water in cases of *furuncle*.

Bromidrosis and *hyperidrosis* have yielded to local applications of from 2 to 5 per cent. aqueous solutions of chloral.

CAMPHORATED CHLORAL is often an efficient remedy for *toothache*, and, when mixed with petrolatum or simple ointment in the proportion of 1 to 7, makes an excellent application in *pruritus* and

other itching diseases where the skin is unbroken. This preparation undiluted has been used in *neuralgia*, painted over the affected nerves.

Cregny employs a 20 per cent. solution of CHLORAL in *anal fissure*, and a 1 per cent. solution is used in *cracked nipples.*

Chloral is frequently used to preserve urine for microscopical examination, though it should not be added to urine reserved for chemical analysis intended to detect the supposed presence of sugar.

Solutions of chloral are used for embalming purposes and the preservation of anatomical specimens.

Internally.—The principal use of CHLORAL internally is to depress the psychic mechanism and produce sleep. It is also employed to depress the reflexes and motor apparatus, and thereby diminish convulsions, and is sometimes useful in diminishing the activities of the sensory nerves.

As a hypnotic it is especially valuable in conditions characterized by excessive cerebral activity, such as *insomnia* resulting from overwork or worry, and in the wakefulness of many acute diseases —*typhoid*, *typhus*, and other *fevers*, *delirium tremens*, and *puerperal mania*—it is a remedy of well-known efficacy. Its depressing effects should always be guarded against during the active course of disease, as well as in delirium tremens where great cardiac weakness already exists. The insomnia of convalescence would usually indicate its use.

On account of its powerful depression upon the motor mechanism it is a valuable drug in treating the various *convulsions* and *spasmodic disorders of childhood*, such as *whooping cough*, *laryngismus stridulus*, *status epilepticus*, and *myoclonus*.

In *asthma*, *tetanus*, *uremic convulsions*, *hiccough*, *strychnine-poisoning*, and *hysteria* chloral has proved a useful remedy.

Chloral is useful in relieving the pains of *carcinoma* of the stomach; it is extremely valuable in restraining *chordee*, and in painful contractions of hollow viscera it is valuable, as in *colic*, in *gall-stone*, in *cystitis*, etc.

Certain forms of *epilepsy*, particularly the nocturnal variety, are benefited by this drug.

The reflex *vomiting* in *pregnancy* is sometimes relieved by either the internal administration of chloral or by enemas. It has also been used to depress the reflexes in *sea-sickness*.

It has given excellent results, used in rectal enemata, in the treatment of *puerperal eclampsia.*

Spasmodic rigidity of the os uteri is greatly reduced by a medicinal dose of this remedy, and, while its action on the sensory mechanism is feeble, it is nevertheless frequently efficient in modifying the *pains of labor* and in quieting the alarm and allaying the nervous excitement of the mother.

There are certain other pains of moderate intensity, especially those of *neuralgia*, which are temporarily more or less relieved by

chloral. Its anodyne effect, however, is too transient to render chloral very popular as an analgesic.

A combination of morphine and chloral is a very efficient anodyne and hypnotic in sleeplessness due to pain, which is palliated by this combination with less digestive disturbance than if the former drug had been used alone, and less cardiac depression than if the latter had been the sole remedy, the medicines thus aiding each other and serving the twofold purposes of mitigating pain and inducing sleep.

In *sthenic fevers* chloral is an admirable remedy, not only as an antipyretic, but in allaying nervous irritability, restlessness, and excessive cardiac action. It dilates the blood-vessels, causes diaphoresis, and sleep is often of great service.

Contraindications.—Fatty heart; marked respiratory weakness, whether due to acute or chronic diseases of the lungs; atheromatous degeneration of the blood-vessels.

The drug should be administered cautiously, the patient being uninformed as to its nature in certain nervous diseases, lest he acquire the chloral habit.

Administration.—As is recommended in the case of all drugs, only the purest article should be prescribed. Frequently the untoward symptoms of chloral are due more to the impure article than to any idiosyncrasy against it. The recrystallized form alone should be used, the first dose administered not exceeding from 15 to 20 grains (1.0 to 1.2 Gm.), repeated as occasion may demand. Ordinarily a maximum dose should not be given oftener than once in forty-eight hours.

Children bear chloral well, and, as a rule, 1 grain (0.06 Gm.) may be prescribed for each year of the child's age.

Enemas of chloral may be rendered less irritating by mixing the drug with the yolk of an egg and milk. Chloral should always be well diluted when given internally, especially when combined with sodium or potassium bromide. Its disagreeable taste may be partially disguised by mixing the solution with peppermint water and elixir or syrup of orange. It should not be given in strong alcoholic solutions.

Chloralformamīdum—Chloralformamīdi—Chloralformamide. *U. S. P.*

(CHLORALAMIDE.)

Definition.—A crystalline solid [$CCl_3.CH(OH)NH.COH$] made by the direct union of formamide and anhydrous chloral.

Description and Properties.—Chloralamide occurs as colorless, shining, odorless crystals, having a faintly bitter taste. It is soluble in 18.7 parts of water and in 1.3 parts of alcohol. Readily soluble in glycerin, ether, acetone, and acetic ether.

Dose.—10–30 grains (0.65–2.0 Gm.).

Physiological Action.—Chloral formamide is not so irritating to mucous membranes as chloral. Upon the digestive system it does

not differ essentially from chloral. Its influence upon the circulation is very feeble, producing no perceptible effect upon the pulse in medicinal doses. Its effect upon the cerebral cortex is as pronounced as that of chloral, but in medicinal doses it has no apparent influence upon the spinal cord. Moderate doses seem to stimulate the respiratory mechanism. The temperature is uninfluenced by medicinal doses.

Therapeutics.—It is not employed externally and locally. Its therapeutic uses are similar to those of chloral. As a hypnotic it is said by some observers to be superior when there is cardiac or respiratory weakness. Robinson[1] has not found it free from cardiac depressing qualities. On the other hand, Hagemann and Hüfler recommend it for the relief of cardiac *asthma.* It is much pleasanter to take than chloral. In the *insomnia of neurasthenia* it is especially valuable, and, in conjunction with potassium bromide, is preferable to a like combination with chloral in cases of *seasickness.*

Administration.—It is best given in aromatic elixir or some other dilute alcoholic vehicle. Simple syrup slightly acidulated with hydrochloric acid, beer, and sweet wine are also recommended as pleasant menstrua. When given at night for insomnia the medicine should be taken upon an empty stomach, about one hour before sleeping-time.

Unofficial Chloral Allies.

Croton-chloral (Unofficial).—*Origin.*—Prepared by passing dry chlorine gas into acetic aldehyde, resulting in the formation of butyl-chloral, which is separated by fractional distillation, and water added.

Description and Properties—Butyl-chloral occurs as a heavy, colorless oil, having an odor resembling that of chloral. The hydrate (croton-chloral hydrate) used in medicine is in the form of white scales, of a silky luster, nauseous taste, and a peculiar fruit-like odor. It is freely soluble in alcohol, ether, glycerin, and hot water, but not easily soluble in cold water. Its solutions are unstable, and are decomposed if kept on hand even for a short time.

Dose.—3–20 grains (0.18–1.2 Gm.).

Incompatibles and *Synergists* are the same as for chloral.

Its *physiological action* and *therapeutics* are quite similar to those of chloral. It was at one time thought that its analgesic properties were more pronounced than chloral and was highly recommended in facial neuralgia. For the severe cases it is worthless, and for the milder cases other analgesics are far better. It has now little practical use.

Chloral-ammonium.—Obtained by passing a rapid current of dry ammonia through a solution of anhydrous chloral and chloroform as long as it is absorbed. Its chemical name is *trichloramidethylic alcohol.* It occurs as small, white acicular crystals, and is soluble in alcohol and slightly soluble in water, although the aqueous solution is unstable.

Dose.—15–30 grains (1.0–2.0 Gm.).

It has no advantages over chloral.

Chloralose.—Prepared by heating equal quantities of anhydrous chloral and dry glucose; hence the name, *chloral-ose.*

Description and Properties.—It occurs in the form of fine needles, completely volatilizing without decomposition. It has an acrid, nauseous taste, and is soluble in hot water and in alcohol.

Dose.—2–10 grains (0.12–0.6 Gm.).

Chloralose has been found to be more depressing than chloral.

[1] *Deut. med. Woch.*, 1889, No. 49.

Hypnal.—A compound of chloral and antipyrine, known as *monochlorantipyrine*. A similar preparation containing more chloral is called *dichloralantipyrine*.

Description and Properties.—It occurs in the form of transparent, rhombic crystals, odorless and tasteless, soluble in from 5 to 6 parts of water.

Dose.—5–20 grains (0.35–1.3 Gm.).

The addition of the antipyrine to increase analgesia, while hypothetically good, has not proven of service.

Ural—Chloral-urethane—Uralium.—A compound of urethane and chloral hydrate.

Description and Properties.—A crystalline body, soluble in alcohol and ether, insoluble in cold water, and decomposed by boiling water.

Chloretone—acetone chloroform—is the trade name of an old chemical compound, trichlopseudo butylalcohol.

Description and Properties.—It is a white, crystalline substance, sparingly soluble in cold water, but freely soluble in hot water, ether, alcohol, and chloroform. It has a camphoraceous odor and a not unpleasant taste.

Dose.—5–10 grains (0.30–0.60 Gm.) or even double this dosage. Best administered in powders or in alcoholic menstruum.

This is undoubtedly a useful hypnotic with an action very similar to that of chloral, but if the recent studies of Impens are to be trusted, it is 2½ times as poisonous as chloral. Chloretone is an excellent antiseptic as well as a hypnotic and has been widely used as a dusting-powder for wounds. It has also been employed in the eye and is a marked local anesthetic. Poisonous local effects are reported, however—intense local edema, etc.

Isopral is a closely related compound (trichloriso propyl alcohol).

Hypnone.—As a hypnotic a much weaker substance than chloral, although it has found some advocates as a remedy for the insomnia of alcoholism. Toxic doses paralyze the heart and respiration. It should be given in capsules.

Acetōnum—Acetōni—Acetone. *U. S. P.*

Definition.—A liquid containing not less than 99 per cent. by weight of absolute acetone. (U. S. P.)

Acetone is chemically dimethyl-ketone (CH_3COCH_3). It is present to a considerable extent in crude wood alcohol.

Description and Properties.—It is a clear, colorless, mobile, neutral liquid, inflammable, and having an ethereal odor and taste. Specific gravity, 0.790 (25° C.); boiling-point, 56.5° C. It is miscible with water and alcohol in all proportions, and is an excellent solvent for fats, resins, rubber, etc. Iodoform is formed when acetone is slightly warmed with an alkali and iodine (basis of method for determining acetone in diabetic urine). Acetone is used widely in the manufacture of chloroform, iodoform, and sulphonal. A number of oleoresins (aspidium, capsicum, ginger, lupulin, and pepper) formerly prepared (U. S. P. 1890) with ether are now prepared with acetone.

Physiological Action.—Acetone resembles ethyl alcohol in its action. It is more potent than ordinary alcohol, as a rule. This may be due to delayed elimination, as is the case in wood-alcohol poisoning, which latter, volume for volume, is less poisonous than ethyl alcohol, but being eliminated more slowly becomes practically more poisonous.

Related Compounds.—When a phenyl radical (C_6H_5) takes the place of one of the methyl groups in acetone, the resulting compounds is phenyl-methyl-ketone ($C_6H_5COCH_3$), also known as acetophenone. This has been used as a hypnotic under the name of *Hypnone*. It is a liquid above 20.5° C. *Malarine* is a condensation product of acetophenone and paraphenetidin. It is usually employed in the form of the citrate.

Salacetolum is a salicylic acid ester of acetol, which is an alcohol

(CH_3COCH_2OH) derived from acetone; proposed as an antirheumatic.

Aceto-acetic acid, also called diacetic acid (CH_3COCH_2COOH), or acetone in which a hydrogen atom has been replaced by ($COOH$), is found in the urine of many patients suffering from diabetes mellitus. This acetone is thought to be a decomposition product of diacetic acid.

NARCOTICS.

Ōpium—Ōpii—Opium. *U. S. P.*

Definition.—The concrete, milky exudation obtained by incising the unripe capsules of *Papaver somniferum* (L.), and yielding in its normal moist condition not less than 9 per cent. of crystallized morphine when assayed.

The poppy from which opium is derived is indigenous in Western Asia and cultivated in Egypt, Persia, Asia Minor, the elevated plains of India, and in some parts of Europe.

Description and Properties.—Opium appears in irregular or subglobular cakes—with the remnants of poppy-leaves and the fruit of a species of Rumex adhering to their surfaces—plastic or of a harder consistence, chestnut-brown or darker, and somewhat shining internally, showing tears, and fragments of vegetable tissue. It has a sharp, narcotic odor and a peculiar, bitter taste. This description applies to the Smyrna, Levant, Turkey, and Constantinople opium. There are, however, a number of other varieties—viz.: 1. Egyptian, flattened, roundish cakes; 2. Persian, black, cylindrical sticks, or small cakes or balls, wrapped in paper; 3. Indian, flat squares covered with mica and wax or an oiled-paper wrapper; 4. Chinese, oblate-spheroidal masses wrapped in white paper; 5. European.

Opium contains about twenty different alkaloids, either in a free state or in combination with some acids. The principal alkaloids, in the order of their medical importance, are *morphine*, *codeine*, *narceine*, and *thebaine;* others are *narcotine*, *papaverine*, *cryptopine*, *pseudomorphine*, *protopine*, *hydrocotarnine*, *laudanine*, *cadamine*, *rheadine*, *meconidine*, *laudanosine*, *lanthopine*, *gnoscopine*, and *oxynarcotine*.

The following constituents of opium are in some respects important: *Meconic acid*, *meconin*, *meconoiosin*, and *porphyroxin*.

In addition to the above, opium contains these substances, making it one of the most complex drugs in materia medica: *Mucilage*, *resin*, *fats*, *essential oil*, *glucose*, *caoutchouc*, *ammonium*, *calcium*, and *magnesium salts*, and *odorous* and *coloring-matters*, besides certaing impurities and adulterants, such as stones, fruits, leaves, starch, water, lead, etc.

The total amount of active alkaloids in opium may vary from 5–28 per cent., variations in morphine alone showing from cipher to 22 per cent. As opium containing less than 9 per cent. morphine is supposed not to enter the United States, the average of most samples obtained is about 10 per cent., but in the smoking extract lower grades are employed; the Smyrna and Patna varieties; these frequently contain only 2–4 per cent. of morphine.

Dose.—¼–2 grains (0.015–0.12 Gm.) [1½ grains (0.1 Gm.), U. S. P.].

The percentage of other alkaloids varies greatly, narcotine which occurs in amounts of from 1–8 per cent. is practically the only other alkaloid of moment.

As to the chemistry of morphine itself, the structural formula is still undecided.

Official Preparations.

Ōpii Pūlvis—Ōpii Pūlveris—Powdered Opium.—*Dose*, ¼–2 grains (0.015–0.12 Gm.) [1 grain (.065 Gm.), U. S. P.].

Powdered opium should yield not less than 12 nor more than 12.5 per cent. of crystallized morphine.

Acētum Ōpii (10 per cent.)—**Acēti Ōpii—Vinegar of Opium.**—*Dose*, 3–15 minims (0.18–1.0 Cc.).

Extrăctum Ōpii (20 per cent. of morphine)—**Extrăcti Ōpii—Extract of Opium.**—*Dose*, 1/6–1 grain (0.01–0.06 Gm.).

Emplăstrum Ōpii (6 per cent. of extract of opium)—**Emplăstrum** (acc.) **Ōpii—Opium Plaster.**—For external use.
Formula: Extract of opium, 60; Burgundy pitch, 180; lead plaster, 780; water, 80.

Opium Deodorātum (12 to 12.5 per cent. of morphine)—**Ōpii Deodorāti—Deodorized Opium** (DENARCOTIZED OPIUM).—*Dose*, 1/4–2 grains (0.015–0.12 Gm.).

Opium Granulātum (12 to 12.5 per cent. of crystallized morphine).—*Dose*, 1 grain (.065 Gm.), U. S. P. Now used for making tr. opii instead of using the opii pulvis.

Pĭlulæ Ōpii (1 grain, or 0.065 Gm., in each pill)—**Pĭlulas** (acc.) **Ōpii—Pills of Opium.**—*Dose*, 1 or 2 pills.

Pŭlvis Ipecacuănhæ et Ōpii—Pŭlvis Ipecacuănhæ et Ōpii—Powder of Ipecac and Opium (DOVER'S POWDER).—*Dose*, 5–10 grains (0.3–0.6 Gm.).
Formula: 1 grain (0.06 Gm.) opium, 1 grain (0.06 Gm.) ipecac, 8 grains (0.5 Gm.) sugar of milk, in every 10 grains (0.6 Gm.).

Tinctūra Ōpii (10 per cent.)—**Tinctūræ Ōpii—Tincture of Opium** (LAUDANUM).—*Dose*, 5–15 minims (0.3–1.0 Cc.).
13 minims (0.78 Cc.) represent about 1 grain (0.06 Gm.) of opium.

Tinctūra Ōpii Camphorāta—Tinctūræ Ōpii Camphoratæ—Camphorated Tincture of Opium (PAREGORIC).—*Dose*, 1/2–4 fluidrachms (2.0–15.0 Cc.).
Formula: Powdered opium, 4; benzoic acid, 4; camphor, 4; oil of anise, 4; glycerin, 40; diluted alcohol, to 1000. Prepared by maceration and percolation. 4 fluidrachms (15.0 Cc.) represent about 1 grain (0.06 Gm.) of opium.

Tinctūra Ōpii Deodorāti (10 per cent.)—**Tinctūræ Ōpii Deodorāti—Tincture of Deodorized Opium.**—*Dose*, 5–15 minims (0.3–1.0 Cc.).

Tinctūra Ipecacuănhæ et Ōpii—Tinctūræ Ipecacuănhæ et Ōpii—Tincture of Ipecac and Opium (TINCTURE OF DOVER'S POWDER).—*Dose*, 5–15 minims (0.3–1.0 Cc.).
10 minims (0.6 Cc.) contain 1 grain (0.06 Gm.) each of opium and ipecac.

Trochĭsci Glycyrrhīzæ et Ōpii—Trochĭscos (acc.). **Glycyrrhīzæ et Ōpii—Troches of Liquorice and Opium.**—*Dose*, 1 to 3 troches.
Each troche contains about 1/12 grain (0.005 Gm.) of opium.

Vīnum Ōpii (10 per cent.)—**Vīni Ōpii—Wine of Opium.**—*Dose*, 5–15 minims (0.3–1.0 Cc.).

The *description and properties* of the official alkaloids of opium and their salts are as follows:

Morphīna—Morphīnæ—Morphine.—Colorless or white, shining, prismatic crystals, or fine needles, or a crystalline powder, odorless, having a bitter taste, permanent in the air. Soluble in 3330 parts of water, in 168 parts of alcohol, in 1040 parts of water at 80° C., and in 36 parts of boiling alcohol. It melts at 254° C. *Dose*, 1/8–1/4 grain (0.008–0.015 Gm.) [1/2 grain (0.1 Gm.), U. S. P.].

Morphīnæ Acētas—Morphīnæ Acetātis—Morphine Acetate.—A white or faintly yellowish-white, crystalline or amorphous powder, having a faint, acetous odor and a bitter taste. Soluble in 2.5 parts of water and in 21.6 parts of alcohol. On protracted exposure to the air the salt gradually loses some acetic acid, becoming less soluble. It should be kept in dark amber-colored, well-stoppered bottles. *Dose*, 1/8–1/4 grain (0.008–0.015 Gm.).

Morphīnæ Hydrochlōridum—Morphīnæ Hydrochlōridi—Morphine Hydrochlorate.—White, feathery needles, of a silky luster, or minute, colorless, cubical crystals, odorless, having a bitter taste, permanent in the air. Soluble in 17.2 parts of water and in 42 parts of alcohol at 25° C. *Dose*, 1/8–1/4 grain (0.008–0.015 Gm.).

Morphīnæ Sŭlphas—Morphīnæ Sulphātis—Morphine Sulphate.—White, feathery, acicular crystals, of a silky luster or in cubical masses, odorless, of a bitter taste, permanent in air. Soluble in 15.3 parts of water and in 465 parts of alcohol at 25° C. *Dose*, 1/8–1/4 grain (0.008–0.015 Gm.).

Codeīna—Codeīnæ—Codeine.—White or nearly translucent, orthorhombic prisms, or octahedral crystals, or a crystalline powder, odorless, having a faintly bitter

taste, and slightly efflorescent in warm air. Soluble in 88 parts of water and in 1.6 parts of alcohol at 25° C. *Dose*, ¼–2 grains (0.03–0.12 Gm.).

Codeinæ Phŏsphas — Codeinæ Phosphātis — Codeine Phosphate.—Fine white crystals. Bitter taste. Soluble in 2.25 parts of water and 261 parts of alcohol at 25° C. *Dose*, ½ grain (0.03 Gm.), U. S. P.

Codeinæ Sŭlphas—Codeinæ Sulphātis—Codeine Sulphate.—Long glistening white crystals, efflorescing in the air. Soluble in 30 parts of water and 6.25 parts of alcohol at 25° C. *Dose*, ½ grain (0.03 Gm.), U. S. P.

Pŭlvis Morphinæ Compŏsitus—Pŭlveris Morphinæ Compŏsiti—Compound Powder of Morphine (TULLY'S POWDER).—*Dose*, 5–15 grains (0.3–1.0 Gm.).

Formula: Morphine Sulphate, 1.5; Camphor, 32; Glycyrrhiza, 33; Precipitated Calcium Carbonate, 33; Alcohol, q. s. to 100.

Antagonists and Incompatibles of Opium and its Alkaloids.—The physiological antagonists are atropine, strychnine, coffee or caffeine. Quinine antagonizes some of the cerebral effects of the drug, while tartrate of antimony and potassa (tartar emetic) and digitalis oppose its action on the intracranial circulation. The incompatibles are alkalies, tannic acid and infusions containing it, and salts of lead, iron, copper, mercury, and zinc.

The following are incompatible with morphine and its salts: iodine and iodides, bromine and bromides, Fowler's solution, and sodium borate.

Synergists.—The hypnotic action of opium is aided by the hypnotics; its anodyne influence is enhanced by belladonna and cocaine, and its sudoriferous effects by ipecacuanha.

The **physiological action** of opium differs in some respects from that of morphine or codeine, and will therefore be described first.

Externally and Locally.—Applied to the unbroken skin, opium possesses feeble analgesic properties, and from mucous membranes or raw surfaces it is readily absorbed, producing slight anodyne effects.

Internally.—Digestive System.—Its prominent action is upon the secretions—checking that from the salivary glands, causing great dryness of the mouth and consequent thirst—largely diminishing those from the stomach, and reducing the bile and pancreatic juice secreted. In fact, every secretion of the body is lessened except the perspiration, the cause being the depressing influence of the drug upon the secretory centers in the medulla. It may be added that the peristaltic movements of the digestive apparatus are reduced, which, together with diminished secretions, impair digestion and produce constipation.

The sensation of hunger is invariably diminished under its administration.

The action upon the intestines, however, varies with the dose administered, moderate or full medicinal doses checking peristalsis and promoting constipation. On the other hand, very large or very small doses increase peristalsis, the former augmenting this effect, and producing violent movement of the bowels through the drug's paralyzing action on the splanchnic inhibitory fibers of the intes-

tine, so that inhibition is removed and peristalsis reinforced. Very small doses act as purgatives when by some reflex disturbance, such as a tender ovary, the peristalsis is inhibited. It is not yet certain whether this action is largely due to local causes, as morphine is excreted into the intestines, or is of central origin. Minute quantities, by partially benumbing the inhibitory nerves or diverting the stimulus from them to the stimulating fibers, relieve constipation. This action is rendered serviceable in the similar constipation accompanying lead poisoning, the metal constipating the patient not only by its astringent action, but also by the tetanic spasm of the intestines caused by the irritating action of the lead upon the mucous membrane. The feces are held by spasmodic intestinal contraction, relief of which by a small dose of opium, sufficient to induce peristalsis, will be followed by evacuation.

Circulatory System.—Small doses accelerate the pulse, rendering it fuller and firmer, and dilate the arterioles, though increasing arterial tension. The chief activity of opium is on the central nervous system. Large doses, while primarily quickening, soon retard the heart's action, rendering the pulse slow. This influence is occasioned by stimulation of both ends of the vagus. Should the dose be lethal, the pulse may become rapid and weak from over-stimulation, and consequent exhaustion of the vasomotor center and pneumogastric nerves. As asphyxia deepens, the heart grows weaker, but usually continues beating after respiratory failure.

Nervous System.—One of the early symptoms of taking opium is a condition of well-being—a euphoria. In it the patient is in a state of dreamy consciousness; the skin is warm and pleasant, and all outside worries, cares, pains, or distresses are cut off from the attention. This is narrowed to the patient's own feeling of happiness. Preceding the full development of the euphoria there is little doubt that a certain amount of primary stimulation takes place, This may be due to the increased blood-supply, frequently manifesting itself in the skin by itching, or it may result from primary irritation, although experiments on lower animals have induced many observers to question the occurrence of any primary stimulation. In the habitué there is no doubt of the stimulation of the initial stages, but in this class an entirely different series of physiological and psychological activities is at work. In the stage of euphoria a certain heightening of the imagination occurs, particularly in certain types of mental organization. This readily becomes incoördinated, however, and very frequently highly exaggerated, leading to the characteristic fantasies colloquially termed "pipe dreams." Sleep follows or intermits in this stage. In the light grades of sleep, the patient may be easily aroused, and, as a rule, when the outside irritant is sufficiently acute to enter into the field of attention, the sleeper is suddenly and usually thoroughly aroused. He often awakens with a sudden start—is keenly alive to the surroundings, and if unnecessary to bestir himself, sinks back into slumber. Very often the sleep is a fitful, restless sleep, with semi-waking

periods and short naps seeming to extend over very great periods of time. In the more profound sleep, awakening is difficult and the patient, after being aroused, sinks back into a profound coma.

On awakening, nausea and vomiting are usual, often a severe and miserable headache, which persists a part of the following day.

Opium is one of the most powerful analgesics known. Pain is relieved, probably through the depressing influence of the drug on the perceptive centers in the brain, although it is possible that the entire sensory apparatus, the peripheral ends of the sensory nerves, the conducting path in the spinal cord, and the receiving cerebral center are more or less influenced by the drug.

The action of opium on the spinal cord is complex, since it contains a number of alkaloids which resemble strychnine as well as morphine, whose action is almost entirely cerebral. In the lower animals and in children there is increased reflex excitability from the action of codeine, narcotine, and thebaine, the last resembling strychnine very closely in its action on the reflex motor mechanism of the cord.

Respiration.—The action of opium on the medullary centers is very pronounced, particularly upon the respiratory center.

In very small doses opium slightly stimulates respiration; in full or large doses it is a strong respiratory depressant, its action being upon the center in the medulla. Death is usually caused by paralysis of respiration, the respirations sinking to 6–8 or even less to the minute, and becoming shallower and shallower. In the late stages of poisoning Cheynes-Stokes respiration usually develops.

Absorption and Elimination.—Opium is rapidly absorbed, and is eliminated chiefly by the gastro-intestinal mucous membrane and very little by the kidneys.

Moderate quantities of the drug are oxidized in the body, though when large doses are administered opium may be found unchanged in the urine. It is also excreted in the bile, in the milk, and to some extent in the sweat, which is largely increased by opium, particularly when the drug is combined with ipecacuanha, as in Dover's powder. The sweat is the only secretion augmented by opium, although the manner in which sudoriparous glands are stimulated is not positively known—whether centrally or peripherally.

All other secretions are diminished by opium.

The reabsorption of opium may be prevented by frequently washing out the stomach and intestines, from which viscera the drug is mainly eliminated.

Metabolism.—The action of opium on metabolism is very marked. It locks it up. Lactic acid occurs in the blood from defective oxidization. It diminishes internal cell-oxidization; by limiting muscular activity it lessens the muscle metabolism; and by diminishing the excursions of the respiratory muscles, limits respiratory oxidation and CO_2 formation. Patients may be kept alive a long period of time under the administration of opium, and it plays a very important rôle in the feeding habits of the Orientals.

Temperature is at first raised, but later lowered when free diaphoresis and muscular quiescence are established.

Eye.—The pupils are minutely contracted by large doses, the *modus operandi* not being fully understood, though probably the action is due to stimulation of the oculomotor center. The pupil usually dilates just before death.

Untoward Action.—Headache, disturbances of hearing, muscular tremor or temporary paralysis, itching of the skin with or without eruption. In case the latter sympton appears, it is commonly in the form of a small red spot resembling roseola. An erythematous inflammation may affect the mucous membrane of the mouth and throat.

Morphine has produced paresthesia of the sense of taste, as well as spasm of accommodation of the eye and edema of the eyelids. Many other untoward manifestations occur, even under minute doses, in persons having an idiosyncrasy against the drug.

Tolerance.—It is a notable fact that the body may become readily accustomed to morphine, and that a distinct tolerance becomes established. Chronic morphine-takers may use enormous quantities, some as high as 100 grains of morphine a day. Whether there is formed in the body an immune substance, thus permitting of such large dosage is not yet established. The researches on dogs by Faust and others would seem to show the possibility of an antitoxic substance being formed, but the question is still open for further investigation. Faust's work also showed that the power of the body to oxidize morphine increases.

Poisoning.—Small medicinal doses of opium, as is known, tend to produce moderate excitement, a pleasing sense of freedom from care, and in sleep, tranquil, even happy, dreams. Far otherwise it is with *toxic doses*. Under their influence the entire physiological conditions of the system are perverted. Here the drug exerts its baneful effects, and the mind rapidly succumbs to a power over which it has no control. The period of excitement is fleeting, the predominating desire of the patient being to *sleep*, and from the dull, lethargic stupor which supervenes he is roused only by vigorous and unremitting treatment. Giddiness portends this mental and physical state. The pulse, though still full, diminishes in frequency; the breathing becomes heavy and labored, and finally stertorous; the heart is now apparently seized with an indefinable oppression, and the pupils are visibly contracted; the skin is moist and warm, and the face suffused or at length of a marked cyanotic hue, cutaneous eruptions being not uncommon. Should relief be not forthcoming, the pulse continues to sink; the drowsiness and subsequent lethargy are followed by a state of true coma; the muscular system is wholly relaxed; the reflexes are obliterated, and death ensues from respiratory failure, the asphyxia being closely accompanied by cessation of the heart's action. The toxic dose ranges from 2 to 10 grs.

In the *treatment of acute opium-poisoning* at least three objects are of paramount necessity: to eliminate the poison, maintain respiration,

and prevent failure of circulation. The first of these may be attained by emptying the stomach and evacuating the bowels. Active stimulants and irritating emetics are of great service, the latter being assisted by frequent and copious draughts of warm water in the intervals of vomiting, and the doses being large in order to make an impression upon the insensibility of the stomach. Chemical antagonists, such as tannic acid, permanganate of potassium, should be tried. Physiological antagonists, as caffeine, in hot strong coffee or tea (with tannin), and atropine, are the most efficient. Too much atropine should not be administered. Hot saline infusions are occasionally very helpful in diluting the poison in the blood, Counterirritants, flagellation, shouting in the ear, may rouse the patient from his lethargy. Artificial respiration by Sylvester's method, or by a pump is imperative in the very toxic cases. Awakening the patient is very helpful in aiding respiration.

Chronic opium-poisoning, resulting from the habitual use of opium, its most active constituent morphine, or its salts, is undoubtedly one of the most pernicious habits to which the human body can be subjected, its mental, moral, and physical phenomena being among the saddest and most terrible known to therapeutics.

The conditions inducing the opium habit are frequently caused, or are largely influenced, by the therapeutic employment of the drug—as was the case with De Quincey, whose graphic analysis of the Pleasures and *Pains* of opium, if possibly to be taken *cum grano salis*, is at once the most powerful and the most eloquent ever written. The patient who has once experienced the anodyne influence of the drug—as captivating to his senses as though it were a draught of the fabled Lethe—readily yields to it upon the slightest occasion, as, for instance, to alleviate trivial indispositions for which, in ordinary circumstances, he would ridicule the idea of medical treatment. With repeated indulgence—often promoted by a casuistic reasoning of which by degrees the subject is scarcely conscious, or by persistent and intentional deception—comes the craving which knows no restraint, and which can be quieted only by complete mental and physical regeneration or the merciful release of death.

The symptomatology observed in the chronic habitués varies considerably. Many people take opium or morphine for many years without showing many evil effects. Beyond a marked grade of peculiar anemia, often skilfully hidden by women, and certain eccentricities of behavior, even the trained observer may not be able to detect even the confirmed habitué, especially when such is found under good hygienic and social conditions. These high-grade habitués often live a sweet-do-nothing existence, their habit constituting one of the family skeletons.

In the more abject phases severe anemia, with marked pallor, extreme emaciation, and greatly depreciated physical, mental, and ethical powers are characteristic.

During the life history of practically every habitué attempts are made to overcome the habit. The discontinuance of the drug in-

variably brings on a series of abstention or withdrawal symptoms characterized mainly by stages of vasomotor paresis. Thus, diarrhea with marked painful peristalsis, running from the nose and eyes, intense neuralgic pains, and a most distressing restlessness are very constant. If the patient can fight it out for thirty-six to seventy-two hours these symptoms abate, and there is hope for a cure, temporary at least.

In the treatment of this condition much can be accomplished from the purely personal side. Treatment is usually best carried out in a trustworthy sanitarium, where a reliable trained nurse should be in constant attendance. This surveillance should be continued long after the drug has been discontinued and the cessation of active treatment. A morphine habitué is by no means cured when the drug is discontinued. The general outline will consist of substituted sensations, substituted ideas, and general tonic and supportive treatment. To accomplish the former purpose, after almost complete withdrawal of the drug has been brought about, codeine, heroin, dionin, hyoscine may be used to create a sense of euphoria, which differs in some respects from the old euphoria of the drug. One of the best hypnotics is a combination of sulphonal with a vegetable neurotic like conium or hyoscyamus. The bromide salts in large doses may be employed. The morphine user is always a victim of toxemia from arrested functions of the kidneys, liver, and adrenals, and intestinal antiseptics, laxatives, and cathartics are a necessary part of the treatment. Hydrotherapy properly employed is invaluable. Static electricity or electric baths are of great value in some cases, but not in all. The immediate surroundings of the patient should be made as pleasing as possible. Food and medicine should be given in the most agreeable forms consistent with usefulness, and the same kind of attention paid to every method of treatment employed.

Suggestion is a potent factor in the treatment of morphinism, and the physician should employ it constantly and encourage his patient in every possible way. After the withdrawal of the morphine, the treatment should combine nerve and mental rest, tonics, diversion, and, by all means, elimination, suggestion, encouragement, and close surveillance for some months. An excellent tonic and supportive drug during the withdrawal of morphine is strychnine nitrate in small doses frequently repeated (gr. $\frac{1}{200}$), so as to secure a cumulative effect.

The treatment of so dire a malady—for such the chronic use of opium must be regarded—demands the utmost forethought, patience, and tact. The method of sudden, absolute withdrawal of the drug is admitted by the wisest observers to be fraught with danger commensurate with that of the indulgence to be overcome. Collapse, delirium, and other serious results have attended so drastic a measure, the general opinion obtaining to-day being that a gradually reduced dose of the drug is the safest and most rational mode of procedure. The conditions are extremely difficult to combat suc-

cessfully, repeated hypodermic injections being eradicated from the system far less readily than opium from the stomach. The moral nature of the patient, too, has become so perverted that little or no reliance can be reposed in his veracity, the physician being thrown upon his unaided resources, supplemented by the untiring vigilance and fidelity of the attendant.

The gravity of the situation should from the first be fully realized, since it is too often simply a case of life or death, the patient being not infrequently seized with the desire of self-destruction in the extremity of mental anguish occasioned by the ordeal imposed by unwonted abstinence. Could he be put upon his honor, and that honor be steadfast, his co-operation would be invaluable. But this assistance is seldom at command, the patient's loyalty of purpose and unswerving resolution, as professed, being wholly subservient to a volition long since weakened, if not annihilated, by pitiful sophistries and moral degradation. Nevertheless, the case must be approached from the sympathetic side, and every means of inspiring confidence employed, remembering that a human will, as well as body, is under treatment, and that mental sanity, as well as physiological health, is to be restored.

While a successful outcome is not always to be expected, much can be accomplished by persistent effort in these cases. They are not hopeless by any means.

Therapeutics.—In a general way the medical uses of opium are—1, to relieve pain; 2, to produce sleep; 3, to lessen reflex irritation; 4, to diminish secretion; 5, to support the system; 6, to act as a sudorific.

Opium is the most important and useful drug known to medicine, as well as the most remarkable in its multifarious applications. It would, therefore, be idle—indeed, well-nigh impossible—to enumerate all the maladies and abnormal conditions for which this invaluable remedy has been employed. It perhaps best represents the typical symptom medicine, being used almost invariably for the relief of one or more symptoms of disease, rather than for its specific or direct curative action upon the disease itself. Unless some special contraindication exists, it may be employed when any of the above medical uses are desired.

Externally and Locally.—It is used to relieve pain, either in the form of an ointment, a liniment, or a suppository, the most popular form, perhaps, being the lead-and-opium lotion.

Internally.—*Pain.*—Either OPIUM or MORPHINE may be used for the relief of *pain*, regardless of the seat or cause. Pain of moderate intensity may often be allayed by other analgesics, such as antipyrine, acetanilid, etc.; but when it is severe or excruciating, it is useless to experiment with other drugs when so potent an agent of relief as opium is obtainable. As a general principle, it should be borne in mind that opium should, if possible, be avoided in all pains of an essentially chronic nature, if the habit is not to be acquired. One is justified, however, in the employment of opium

or morphine indefinitely for the relief of pain or insomnia in incurable cases.

Sleep.—It is not recommended for ordinary use to produce sleep, because of its seductive, insidious action, and the danger of creating in the patient a tendency toward the opium habit. When, however, sleeplessness is occasioned by pain, and in the *insomnia of delirium tremens* or *acute delirium*, opium or some one of its preparations is often an indispensable remedy.

Spasm.—Spasmodic conditions of involuntary muscles, as in cases of *asthma*, the convulsions of *tetanus*, *uremia*, *hydrophobia*, frequently call for a drug as powerful as opium.

When given in proper doses in peritonitis, opium reduces peristalsis and removes the pain, promoting the patient's comfort and supporting his vital powers. It diverts the blood from the congested peritoneum by dilating the cutaneous blood-vessels. Furthermore, it possesses the peculiar property of causing the irritation in the inflamed area to contract reflexly the local blood-vessels, thus diminishing the blood-supply to the diseased part.

It is manifestly of little service beyond its pain-relieving effects in the peritonitides of septic appendicitis or of other acute bacterial peritonitides. If its use tends to mask the symptom of pain in appendicitis, thus rendering diagnosis more difficult, it is to be avoided.

Secretion.—In *dysentery*, *cholera morbus*, and *cholera*, it has been used with excellent results, having also been employed in many cases of excessive secretion in other portions of the body.

Opium is frequently given in *bronchitis* with profuse secretion and irritable cough, in which condition it acts favorably through depression of the reflexes and power to allay irritation and check secretion. In these cases, however, small doses only should be administered, and the condition of the patient carefully watched, especially that of the aged, lest the respiratory apparatus be so depressed that expulsion of the accumulated viscid mucus be impossible and danger of death from suffocation ensue.

Metabolism.—As a supporter of the system when the vital forces are weakened by acute or chronic disease or injury there are few drugs as efficacious as opium. It calms and strengthens the debilitated heart, and secures the patient refreshing sleep, soothing and invigorating his system by means of the much-needed rest. If pain be persistent, wearing seriously upon the sufferer's vitality, opium by its anodyne influence enables him to recuperate during the interval of relief.

In *shock* from severe injury, opium, by benumbing sensation and depressing the reflex mechanism, lessens the danger of cardiac and respiratory failure.

In *pleurisy* it is the most efficient remedy, relieving congestion as in peritonitis, besides reducing the respirations, and consequently the friction of the inflamed pleural surfaces, as well as allaying the pain accompanying each respiration.

Dover's powder is a common and valuable agent in *acute coryza*, it also being one of the most efficient diaphoretics.

Opium is considered the most efficacious remedy in *puerperal septicemia*. It has also been advocated for *hemorrhage*, both active and passive, its greatest utility being manifested in the latter condition. It is particularly valuable in the hemoptysis of phthisis, and useful in hemorrhage in typhoid.

Although frequently used in *continued fevers* of various kinds, it is indicated, as a rule, only during their course—or, rather, after the fever is well established or during its decline—to mitigate its violence or conserve the strength and relieve the nervous manifestations foreboding exhaustion. Clinical experience has demonstrated its inutility, ordinarily, at the onset or climax of such fevers. Even in *exanthematous fevers* opium has proved valuable when the eruption is delayed. The presence of narcotine is said to be of assistance in the treatment of malaria.

As already intimated, the space allotted to this drug will scarcely permit an enumeration of the many disorders for which this remedy has been successfully administered. The independent and thoughtful physician, knowing the chief indications for its use, will find no difficulty in employing opium alike to the relief of the patient and his own satisfaction.

Contraindications.—If avoidable, opium should not be given to children under five years of age. Should the necessity of administration under that age be deemed advisable in the judgment of the physician, it should be remembered that the drug acts with greatly disproportionate power upon the nervous systems of the young, 1 minim (0.06 Gm.) of tincture of opium having caused the death of a child one day old, and a few drops of camphorated tincture of opium having proved fatal to an infant of nine months. The death of a nursing babe is even recorded; the mother having taken a medicinal dose of laudanum.

Opium is contraindicated in excessive bronchial secretion of the aged, during the second stage of pneumonia, in cerebral congestion, and in alcoholism.

Administration.—As has been stated under *Poisoning*, there are many circumstances which modify the action of opium, the young and the old requiring smaller doses and great care in administration. For children the best preparation is paregoric. Females, moreover, need smaller doses than males, since they are more readily affected by the drug and more subject to untoward manifestations, such as nausea, headache, etc.

Caution should be exercised in administering opium to those who have an idiosyncrasy against it. On the other hand, persons addicted to the opium habit require enormous doses to make a medicinal impression.

Agonizing pain seems to antagonize the drug, so that in *peritonitis* or during the passage of *biliary* or *renal calculi*, in *severe neuralgia*, *tic doloureux*, etc., opium is well borne, doses which

under other conditions might produce dangerous symptoms having little effect save to deaden the pain, frequently not even inducing sleep.

In other cases, such as *nephritis*, very small doses may be followed by serious and alarming consequences, continued administration resulting in an accumulation of the drug in the system, owing to defective elimination. Should prolonged administration be desirable, it is necessary to increase the dose gradually in order to produce the requisite effect, because of the growing tolerance to the drug.

Certain preparations are preferable in given conditions. Thus, if it be necessary to produce diaphoresis, Dover's powder or some other combination with ipecac is advisable. When relief of pain, unless it be intense, is desired, small doses of morphine or tincture of opium will usually be sufficient, full doses being required to produce sleep.

The deodorized tincture of opium causes less disagreeable symptoms than the plain preparation, which contains narcotine. Potassium bromide is said to prevent untoward after-effects.

When opium is demanded for its astringent action, it should be given in small or stimulant doses or combined with chalk or with some of the astringents. The camphorated tincture, owing to the camphor it contains, is probably the most astringent liquid preparation of opium, and is therefore preferable in cases of diarrhea, as it is the favorable form as an adjunct to cough-mixtures.

When the prolonged sedative and astringent effect of opium is desired, as in *intestinal hemorrhage*, *diarrhea*, *nausea*, and certain *diseases of the stomach*, an old, dry opium pill or pill of opium and lead is better than any liquid preparation of morphine, owing to its tardy solution.

In *diseases of the rectum* requiring opium a suppository containing the extracts of opium and belladonna is perhaps the best combination to use.

Ovarian and *pelvic pain* more readily succumbs to the anodyne action of codeine than distress in other parts of the body.

When opium is used as a soporific, it is best to combine it with chloral, a small dose only of each being necessary. These unite in their action upon the brain, depressing the heart less than if chloral alone had been given, and are attended by less serious after-effects than had morphine been the sole agent employed.

Opium prolongs the narcotic effect of chloroform, and in certain operations it is good practice to administer a dose of the drug, following it soon with a few inhalations of the anesthetic.

The hypodermic injection of morphine is usually preferable to the internal administration of opium in cases of severe pain, since a smaller dose is required and a much more rapid effect produced, with less danger of affecting the appetite and bowels.

The many circumstances influencing the action of the drug appear to confirm the statement that "there is no *dose* of opium,"

its conduct being wholly dependent upon the age, sex, idiosyncrasies, and condition of the patient. The amounts given under the different preparations are such as experience has shown to be safe ordinarily as the initial ones for adults, succeeding doses being adjusted according to the indications of the individual case.

Contrasts of Opium and its Alkaloids.

It has been pointed out that opium is a very variable body. Its chief action is dependent on morphine, which is found, as a rule, in the largest amounts. Occasionally the morphine strength is low, and thebaine or narcotine percentage high. In this event the tetanizing activities of these alkaloids becomes prominent. The alkaloids in opium seem to show a regular series of gradations in activity from morphine, through papaverine, codeine, and narcotine, to thebaine; in the former of which the cerebral activities are more manifest, while for narcotine and thebaine there is greater action on the spinal reflexes. Narcotine approaches strychnine in this respect.

Morphine is naturally much more certain in its action than opium. Papaverine is intermediate between morphine and codeine, but is a weak alkaloid. Opium possesses greater diaphoretic properties than morphine. Morphine produces more irritability of the bladder and occasions much greater itching of the skin than opium.

Codeine represents a middle activity. It is less depressing to the cerebral functions, and much less poisonous to the medulla; in children its stimulating action on the spinal cord may be manifest. It is much weaker than morphine, and rarely causes the unpleasant after-effects of this alkaloid. Codeine has a more selective action than morphine upon the nerves of the abdominal viscera; is less constipating than morphine or opium, and has comparatively little effect in medicinal doses upon the respiration.

The remaining alkaloids are present in very small quantities and are therapeutically negligible. Narceine was at one time considered highly poisonous, but later research has failed to confirm Claude Bernard's early dicta.

Allied Morphine Compounds.

Heroin—Diacetyl Morphine.—This is an acetic ester of morphine. It is a white crystalline powder, of faintly bitter taste, but practically insoluble in water, but rendered soluble with dilute acids. It is useful as a substitute for morphine as an antispasmodic in cough, and is particularly valuable in respiratory difficulties. It is less of a cerebral depressant. Its use can bring about a habit. *Dose*, $\frac{1}{12}$–$\frac{1}{6}$ grain (0.005–0.1 Gm.).

Dionine—Monacetyl Morphine Hydrochloride.—This is much similar to the preceding, a single acetyl ester entering into the combination. It has much the same properties, but is deemed more poisonous. Severe poisoning has resulted. *Dose*, not to exceed $\frac{1}{5}$ grain (0.012 Gm.).

Peronine.—This is an analogous compound—the benzyl ester of morphine. It is now rarely employed as a remedy. *Dose*, up to 1 grain (0.06 Gm.).

Hūmulus—Hūmuli—Hops. *U. S. P.*

Definition.—The carefully dried strobiles of *Humulus Lupulus* L. bearing their natural glandular trichomes.

Description and Properties.—Ovate, about 3 Cm. long, consisting of a thin, hairy, undulating axis and numerous obliquely ovate, membranaceous scales, the upper portion of which is reticulately veined and the lower parallel-veined, glandular, surrounding a subglobular akene; color of the scales greenish, free from reddish or brownish spots, odor aromatic, and taste bitter, aromatic, and slightly astringent. The active and important constituent is—

Lupulīnum—Lupulīni—Lupulin. *U. S. P.*

Definition.—The glandular trichomes separated from the fruit of *Humulus Lupulus* L.

Description and Properties.—Bright, brownish-yellow, becoming yellowish-brown, resinous, consisting of minute glands which under the microscope are seen to be subglobular, or, rather, hood-shaped, and reticulate—aromatic and bitter.

Dose of Lupulin.—5–30 grains (0.3–2.0 Gm.).

Official Preparations of Lupulin.

Fluidextrăctum Lupulīni—Fluidextrăcti Lupulīni.—Fluidextract of Lupulin.—*Dose*, 5–30 minims (0.12–2.0 Cc.).

Oleoresina Lupulini—Oleoresinæ Lupulini—Oleoresin of Lupulin.—*Dose*, 1–5 grains (0.06–0.3 Gm.).

Physiological Action.—*Internally.*—*Digestive System.*—The action of hops is similar to that of vegetable bitters, augmenting the secretions from the salivary and gastric glands, thereby promoting appetite and digestion.

Circulatory System.—The heart's action is slightly increased, the remedy also raising arterial tension and exciting the cutaneous circulation. Lupulin is a mild somnifacient and diuretic. As a general pain-relieving agent it is to be classed with the milder anodynes. In the *colics* of children it is of great service. In *neurasthenia* and *hysteria* it has a calmative influence, lessening the irritability and often promoting sleep.

The combined tinctures of lupulin and capsicum serve as excellent substitutes for alcoholic stimulants during the treatment of *alcoholism*, as well as being useful remedies in mild attacks of *delirium tremens.*

Administration.—Lupulin and oleoresin of lupulin are best given in pills and capsules respectively. The tincture and fluidextract should be administered in syrup. Aromatic spirits of ammonia forms a good vehicle when it must be given in liquid form.

Lactucārium—Lactucārii—Lactucarium. *U. S. P.*

Definition.—The concrete milk-juice of *Lactuca virosa* L., a biennial rank-smelling herb growing in Europe.

Description and Properties.—It occurs in sections of plano-convex, circular cakes, or in irregular, angular pieces, externally grayish-brown or dull reddish-brown, internally whitish or yellowish, of a waxy luster, heavy narcotic odor, and somewhat bitter taste. It contains lactucin, lactucopicrin, lactucic acid, lactucerin, and wax.

Dose.—5–60 grains (0.3–4.0 Gm.).

Official Preparations.

Tinctūra Lactucārii—Tinctūræ Lactucārii—Tincture of Lactucarium.—*Dose*, ¼–2 fluidrachms (1.0–8.0 Cc.).

Syrupus Lactucarii—Syrupi Lactucarii—Syrup of Lactucarium.—*Dose*, 1–4 fluidrachms (4.0–15.0 Cc.).

Physiological Action and Therapeutics.—It has been thought that lettuce contains a body somewhat resembling hyoscyamine. If this is so the reputed soporific effects are explainable. Its action is in nowise like opium. It is extremely slightly soporific and also diuretic, which properties, especially in the syrup form, render it of some value in cases of *irritating cough*, as well as in *sleeplessness* and *nervousness of children.*

Cănnabis Ĭndica—Cănnabis Ĭndicæ—Indian Cannabis. *U. S. P.*

(Indian Hemp.)

Definition.—The dried flowering tops of the pistillate plant of *Cannabis sativa* L., grown in the East Indies and gathered while the fruits are as yet undeveloped and carrying the whole of their natural resin.

Description and Properties.—The article of commerce consists of bundles of a few flowers, the branches and bracts, and nearly ripe fruit, the whole more or less agglutinated by a resinous exudation. Of a brownish-green color, peculiar narcotic odor, and slightly acrid taste. The exact composition of cannabis is not known. It is an extremely variable drug, and plants in different countries display great diversity in amount of active constituents. It is thought that only the tropical varieties are effective.

The active constituents are not yet definitely isolated. They exist in a mixture of resins and volatile oils, termed for convenience only *Cannabinol;* but no one body that may be said to possess the pharmacological characters of the crude drug has yet been positively determined as to its chemical structure.

The crude drug is commonly called in India "gunjah." "Bhang," "siddhi," or "hashish," the term usually employed—from whose toxic effects, frequently inciting to murder, is said to be derived our word "assassin"—is another form of cannabis appearing as the Arabian confection prepared by mixing aromatics with fruits and dried leaves.

Dose.—2–5 grains (0.12–0.3 Gm.).

Official Preparations.

Extrăctum Cănnabis Ĭndicæ—Extrăcti Cănnabis Ĭndicæ—Extract of Indian Cannabis.—*Dose*, ¼–1 grain (0.015–0.06 Gm.) [⅙ grain (0.01 Gm.), U. S. P.].

Fluidextrăctum Cănnabis Ĭndicæ—Fluidextrăcti Cănnabis Ĭndicæ—Fluidextract of Indian Cannabis.—*Dose*, 2–5 minims (0.12–0.3 Cc.).

Tinctūra Cănnabis Ĭndicæ (10 per cent.)—Tinctūræ Cănnabis Ĭndicæ—Tincture of Indian Cannabis.—*Dose*, 5–20 minims (0.3–1.2 Cc.).

Antagonists and Incompatibles.—Strychnine, caustic alkalies, acids, and aqueous preparations are pharmaceutical incompatibles, precipitating the resin.

Synergists.—Alcoholics, ether, bromides, cocaine, and members of the present group enhance its cerebral effects.

Physiological Action.—*Externally and Locally.*—Its local action on the skin is *nil.*

Internally.—Digestive System.—It is slightly sedative to the stomach, in many persons appearing to promote the appetite and aid digestion. Its use is not followed by constipation or other gastro-intestinal disturbance.

Circulatory System.—A slight acceleration of the pulse is noticeable under full doses.

Nervous System.—In moderate-sized doses after half to one hour there is a marked stimulation of the cerebral activities. The flow of ideas is heightened. Imagination is quickened and in certain types of individuals there may be hallucinations of sight, of hearing, of touch, etc. These are for the most part accompanied by a dreamy state of beatitude, atypical euphoria, comparable in some degree to the euphoria of alcohol or opium. Certain psychological peculiarities are often noted in the mental exaltation. Double consciousness, or sense of divided consciousness, is common, and there is usually a loss of space and time relations. The peripheral nerves of touch and pain are affected, both of these sensations being dulled. There may be heightened reflex irritability in the cord.

Respiratory System.—No marked or uniform action upon the respiration has been observed, it being at times quickened and again retarded.

Absorption and Elimination.—Cannabis is slowly eliminated, though in what manner is unknown, the effects of the drug sometimes persisting for twenty-four or thirty-six hours. Of all the secretions, the urine alone is affected, the amount being increased.

Temperature.—Cannabis has no direct depressing action upon temperature, which, however, may rise during the period of excitation, and be diminished somewhat during sleep.

Eye.—The drug differs from opium in that it dilates the pupil and produces exaggerated vision.

Uterus.—It is considered to be a powerful uterine stimulant, and like properties are usually ascribed to it as an aphrodisiac, though its effect upon sexual desire is not always manifest. It undoubtedly increases the energy of the uterus, though possessing no power to inaugurate uterine contractions when once suspended.

Poisoning.—Large doses of cannabis Indica are wont to produce toxic effects, but these are rarely fatal even in large doses. Cardiac failure is thought to precede respiratory paralysis.

The after-effects of hashish indulgence vary with the physiological and mental peculiarities of the individual. As a rule, they are not disagreeable, though it requires time to eradicate the effects of the poison. Death directly attributable to the drug has not been recorded.

Treatment of Acute Poisoning.—Among antidotes, lemon-juice, coffee, and tobacco have been favorably mentioned. The best treatment appears to be similar to that adopted in cases of chloral- and opium-poisoning.

Chronic poisoning induces a characteristic series of mental symptoms. The effects of continued indulgence, according to the

Makhzan-el-Adwiya, an early treatise, are "weakness of the digestive organs, followed by flatulency, indigestion, swellings of the limbs and face, changes in complexion, diminution of sexual vigor, loss of teeth, heaviness, cowardice, depraved and wicked ideas." The most common effect, however, is the development of insanities which have been known for many years. A number of types are described. Temporary intoxication is the state commonly seen in the hashish cafés of the Orient. The patient represents a medium condition between an alcoholic and an opium intoxication. Hashish delirium represents a severer grade comparable to delirium tremens. The patients are restless and sleepless and chatter unendlessly. Acute maniacal excitement is also found. The patient runs amuck, but may also be melancholic. Chronic mania and dementia represent terminal stages. The mania is usually a happy mania. The dementia is of a classical organic type. A further form of the cannabino-mania needs characterization. He is the shiftless never-do-well—a liar and thief, quite comparable with the degenerated alcoholic, opium, or cocaine habitués.

Therapeutics.—*Externally and Locally.*—Cannabis is very seldom used locally.

Internally.—Cannabis has been discarded as a remedy in many disorders for which it was formerly used. It is, however, still employed to a considerable extent as a hypnotic in *melancholia* and *mania* and for its analgesic action in *neuralgia* and *pruritus.*

Cannabis Indica is of service in functional *impotence*, its action in this disorder being aided by combining it with ergot and nux vomica.

It is a valuable adjuvant to cough-mixtures intended to relieve *tickling* or *irritation of the throat*, as well as to quiet the excessive cough of *bronchitis* or *phthisis*, being superior to opium in this respect, since it disturbs the stomach less and does not produce constipation.

It has been used in *spasm of the bladder*, and in *gonorrhea* and *chordee* it has been found to be a most valuable remedy.

In considering the therapeutics of cannabis Indica reference should be made to its efficacy in *migraine* and *headache*, particularly those present at the menopause. Although as a remedy for the former disorder cannabis has been largely superseded by the adoption of antipyrine and agents of its class, the old use of tincture of gelsemium, combined with tincture of cannabis, serves an important purpose in aborting the distressing attacks of *migraine.* It is useful as a mild hypnotic in insomnia from exhaustion with pain, and is often efficient in severe tic douloureux.

Administration.—The extract should be given in pill form; the tincture and fluidextract, in an alcoholic menstruum. As has been already intimated, different samples vary greatly in strength; it is therefore best to begin with the minimum dose until the force and quality of the preparation be ascertained.

It is advisable to prescribe invariably the preparations of that

particular manufacture which experience has shown to produce samples of uniform strength.

THE MYDRIATIC NARCOTICS.

Because of their narcotic properties, utilized clinically in the treatment of diseased conditions, the following drugs are included in this subdivision of Narcotics. The most important are belladonna, hyoscyamus, and stramonium. They belong to one family of plants, the *Solanaceæ*, and contain active principles—alkaloids—that are very closely related. On account of their characteristic action on the pupil, these drugs are called mydriatics. These active principles, moreover, are confined closely to this family. These alkaloids all contain a tropin nucleus, which is a modified pyridine (a piperidine) to which acid groups are attached.

The tropin base is of particular interest as a starting-point from which these alkaloids can be synthetically constructed. Hyoscyamine is thought to be isomeric with atropine. Hyoscine (scopolamine) is closely related, but probably differs slightly. The composition of these and other related alkaloids is still in dispute. (Some of these are *Duboisine*, *Mandragorine*, *Daturine*, *Atropamine*, *Belladonnine*, *Bellatropine*, *Atroseine*, etc.).

The different plants of this group are: *Atropa Belladonna*, *Hyoscyamus niger*, *Datura Stramonium*, *Datura alba*, *Atropa mandragora*, *Scopola carniolica*, *Scopola japonica*, *Duboisia myoporoides*, and *Anisodus luridus*. Only the more important will be here considered.

Belladŏnnæ Fōlia—Belladŏnnæ Foliōrum—Belladonna Leaves. *U. S. P.*

Definition.—The dried leaves of *Atropa Belladonna* L., yielding when assayed not less than 0.35 per cent. of mydriatic alkaloids.

Atropa Belladonna is a nearly glabrous, herbaceous, perennial plant, from 4 to 6 feet (1.2–1.8 M.) high, bearing dark-purple, bell-shaped flowers and shining purplish-black berries of the size of a cherry. It is found in the woods, chiefly in the mountainous districts, of Central and Southern Europe, and as far east as Asia Minor, Caucasia, and Central Asia. It is cultivated in Europe and in the United States to some extent, being known by the common name of "deadly nightshade."

Description and Properties.—The leaves are from 4 to 6 inches (10–15 Cm.) long and about one-half as broad, broadly ovate, equilaterally narrowed into a petiole, tapering at the apex, entire on the margin, smooth, thin, the upper surface brownish-green, the lower surface grayish-green, both surfaces whitish punctate; odor slight, taste bitterish and disagreeable.

Belladonna leaves contain from 0.2 to 0.6 per cent. of *atropine*, the most important alkaloid, *belladonnine* (probably anhydro-atropine), besides an alkaloid practically identical with *hyoscyamine* and chrysatropic acid.

Dose.—1–5 grains (0.06–0.30 Gm.) [1 grain (0.065 Gm.), U. S. P.].

Official Preparations.

Extrăctum Belladŏnnæ Foliōrum—Extrăcti Belladŏnnæ Foliōrum—Extract of Belladonna Leaves.—*Dose*, 1/8–3/4 grain (0.008–0.048 Gm.) [1/6 grain (0.1 Gm.), U. S. P.].

Emplăstrum Belladŏnnæ (20 per cent.)—**Emplăstrum** (acc.) **Belladŏnnæ—Belladonna Plaster.**—For external use. Should contain not less than 0.38, nor more than 0.42, per cent. of mydriatic alkaloids.

Formula: Extract of belladonna leaves, 300; adhesive plaster, 700.

Tinctūra Belladŏnnæ Foliŏrum (10 per cent.)—**Tinctūra Belladŏnnæ Foliŏrum—Tincture of Belladonna Leaves.**—*Dose*, 5–20 minims (0.3–1.2 Cc.) [8 minims (0.5 Cc.), U. S. P.].

Unguĕntum Belladŏnnæ (10 per cent.)—**Unguĕnti Belladŏnnæ—Belladonna Ointment.**—For external use.

Formula: Extract of belladonna leaves, 10; diluted alcohol, 5; benzoinated lard, 65; hydrous wool fat, 20.

Belladŏnnæ Rādix—Belladŏnnæ Rădicis—Belladonna Root. *U. S. P.*

Description and Properties.—The dried root of *Atropa Belladonna*, yielding when assayed not less than 0.5 per cent. of mydriatic alkaloids. The root occurs in cylindrical, tapering, longitudinally wrinkled pieces, ½ to 1 inch (12–25 Mm.) thick; externally brownish-gray, internally whitish; fracture nearly smooth and mealy, not radiating or showing medullary rays in the thicker roots, except in the layer near the bark; nearly inodorous, of sweetish taste, afterward bitterish and strongly acrid.

The root contains the same constituents as the leaves, with the exception of chrysatropic acid—which is wanting—and in addition a red coloring-principle, *atrosin*, found also in the berries. Young roots have been found to contain proportionately higher percentages of hyoscyamine. The unripe berries contain hyoscyamine, while the process of ripening seems to either convert this alkaloid into atropine or larger quantities of atropine are conveyed to the berries at ripening.

Official Preparations.

Fluidextrăctum Belladŏnnæ Rădicis—Fluidextrăcti Belladŏnnæ Rădicis—Fluidextract of Belladonna Root.—*Dose*, 1–3 minims (0.06–0.18 Cc.) [1 minim (0.05 Cc.), U. S. P.].

Linimĕntum Belladŏnnæ (95 per cent.)—**Linimĕnti Belladŏnnæ—Belladonna Liniment.**—For external use.

Formula: Camphor, 50; fluidextract of belladonna root, 950.

Atropīna—Atropīnæ—Atropine. *U. S. P.*

Definition.—An alkaloid obtained from *Atropa Belladonna* and from other plants of the same family.

Description and Properties.—White acicular crystals, or a more or less amorphous white powder, odorless, having a bitter, acrid taste, gradually assuming a yellowish tint on exposure to air. As it occurs in commerce, it is usually accompanied by a small amount of hyoscyamine. Soluble in 130 parts of water, 3 parts of alcohol, 16 parts of ether, 4 parts of chloroform, and about 50 parts of glycerin.

Dose.—$\frac{1}{120}$–$\frac{1}{40}$ grain (0.0005–0.0016 Gm.) [$\frac{1}{150}$ grain (0.0004 Gm.), U. S. P.].

Official Preparations.

Atropīnæ Sŭlphas—Atropīnæ Sulphătis—Atropine Sulphate. U. S. P.—*Description and Properties.*—A white, indistinctly crystalline powder, odorless, having a very bitter, nauseating taste, permanent in air. Soluble in 0.4 part of water, 6.2 parts of alcohol, 2270 parts of ether, and 694 parts of chloroform. It is usually mingled with a small amount of hyoscyamine sulphate.

Dose.—$\frac{1}{120}$–$\frac{1}{40}$ grain (0.0005–0.0016 Gm.) [$\frac{1}{150}$ grain (0.0004 Gm.), U. S. P.].

Oleatum Atropinæ—Oleati Atropinal—Oleate of Atropine, U. S. P.—Containing 2 per cent. of atropine.

Homatropīnæ Hydrobrōmidum—Homatropīnæ Hydrobrōmidi—Homatropine Hydrobromide.

Definition.—The hydrobromide of an alkaloid obtained by the condensation of tropine and mandelic acid.

Atropine may be broken up, by the action of alkalies, into an alkaloid, tropine, and an aromatic acid, tropic acid. Tropine forms ester-like compounds with many acids; the compounds with aromatic acids are called tropeins. Homatropine is one of these tropeins, formed by the union of tropine and mandelic acid; the latter is phenylglycollic acid $C_6H_5CH<\left(\begin{matrix}OH \\ COOH\end{matrix}\right)$. Tropic acid (the acid of atropine) is phenylhydracrylic acid. $\left(C_6H_5CH<\begin{matrix}CH_2OH \\ COOH\end{matrix}\right)$. Scopolamine (hyoscine) is formed by the union of tropic acid with scopoline, a compound similar to tropine.

Properties.—Small, colorless, odorless, rhombic crystals or crystalline powder, having a bitter taste. Soluble in 5.7 parts of water and 32.5 parts of alcohol. It should be kept in well-stoppered vials protected from light.

Dose.—"Average dose: 0.0005 Gm. = 0.5 milligramme ($\frac{1}{120}$ grain)." U. S. P.

Euphthalmin is a recently introduced mydriatic, having a physiological action very similar to homatropine; it is a mandelic acid derivative of *beta-eucaine*.

Antagonists and Incompatibles.—Muscarine antagonizes the action of belladonna in nearly every particular, and physostigmine, pilocarpus, and aconite counteract many of its effects. Opium antagonizes its action on the cerebrum, pupil, heart, respiration, arterial tension, and kidneys.

Atropine is incompatible with caustic alkalies, tannin, and vegetable infusions containing tannin, an insoluble tannate of the alkaloid being formed.

Synergists.—The mydriatic drugs mentioned aid the action of belladonna.

Physiological Action.—The action of belladonna is dependent upon the amount of atropine it contains.

Externally and Locally.—When locally applied atropine is analgesic, antispasmodic, antisecretory, and mydriatic. When thus used, in combination with absorbable substances—such as alcohol, camphor, animal fats, glycerin, etc.—it diminishes the sensibility of the sensory nerves, and when absorbed from raw surfaces of the skin or from the subcutaneous tissue it is capable of producing systemic effects.

Internally.—Digestive Symptom.—Even small doses produce dryness of the mouth, owing to the greatly diminished secretion of saliva and mucus. The salivary secretion is lessened through paralysis of the peripheral endings of the secretory fibers only of the chorda tympani nerve in the submaxillary gland.

The drug diminishes the secretions from the stomach, liver, pancreas, and intestines possibly in a similar manner. The sweat is diminished through paralysis of the peripheral nerve-endings in the sudoriparous glands. The secretion of milk is reduced by paralysis of the peripheral terminations of the secretory nerves in the mammary glands. The secretion from the bronchial mucous membranes is lessened through the depressing influence of the drug upon the nerve-endings. The secretions of the kidneys are not as profoundly altered as are other glandular products.

Atropine is absorbed readily. It breaks up into tropin and tropic acid and has a marked action on the nervous structures.

Unstriped Muscles.—The peristaltic movements of the intestines are generally decreased by atropine. Very large doses are known at times to cause violent peristalsis and thus are thought to be of value in intussusception.

Circulatory System.—Medicinal doses of atropine or belladonna at first retard the pulse, due, it is thought, to a stimulation of the vagus centers, thus inhibiting the action, but it is quickly accelerated and rendered firmer with increased arterial pressure. The primary transitory action is due to a slight stimulation of the vagi roots, the subsequent quickening of the pulse resulting from paralysis of the peripheral ends of the pneumogastric nerve distributed in the cardiac muscle. The inhibition being thus removed, the heart responds to the influence of the accelerator nerves. The center for these nerves in the medulla is also stimulated by the drug, increasing still further the rapidity of the heart's action. The cardiac muscle itself, being stimulated, renders the contractions of the heart more forcible.

Arterial tension is increased not only by the greater rapidity and force of the heart, but also by the contraction of the arterioles arising from stimulation of the vasomotor center. Very large or poisonous doses lower arterial pressure. This effect is produced by exhaustion of the vasomotor center from over-stimulation, resulting in dilatation of the cutaneous arterioles, which lowers arterial tension and flushes the skin. Overwhelming doses may weaken the cardiac muscle itself from over-stimulation, weakening the heart's contraction, as well as paralyzing the terminal nerve-filaments in the muscles of the vessel-walls, and even the muscular fibers

Nervous System.—A full medicinal dose of belladonna stimulates the brain, while large doses—and, in susceptible persons, medicinal ones—may produce hallucinations and delirium, accompanied by spectral illusions. The delirium may be mild, joyful, and talkative, or it may assume a violent type. It may, moreover, persist for a long time, after which the patient sinks to sleep, induced either by exhaustion from the delirium or a secondary depressing action of the drug. The motor area is also stimulated.

The *spinal cord* shares in the stimulation caused by belladonna. The reflexes are at first slightly exaggerated, being afterward diminished. Very often under poisonous doses there is complete motor paralysis, the loss of power occurring first in the lower extremities.

The sensory nerves are depressed, especially when the drug is locally applied, the influence being exerted on their terminal filaments.

Respiratory System.—Medicinal doses quicken and deepen the respirations, owing to stimulation of the respiratory center.

Poisonous doses over-stimulate, and consequently exhaust or

paralyze, the respiratory center, the result being slow and shallow breathing and death from asphyxia.

Absorption and Elimination.—Atropine is rapidly absorbed and eliminated, chiefly by the kidneys, but also to some extent by the bowels. It is thought that part of the drug is oxidized by the liver.

Temperature.—Large doses slightly increase bodily heat, probably by increasing the circulation and respiration, consequently augmenting combustion. Ott maintains that belladonna stimulates the heat-center. In cases of severe poisoning from the drug the temperature rapidly falls.

Eye.—Belladonna dilates the pupil, whether locally applied or taken internally. The manner in which atropine dilates the pupil has not yet been satisfactorily explained, the prevailing opinion being that the action is due to a paralysis of the peripheral ends of the oculomotor nerves. The dilatation may be rendered greater by stimulation of the cervical sympathetic, but the fully dilated pupil is irresponsive to light and accommodation.

Atropine increases intraocular tension, rendering it a dangerous drug in glaucomatous conditions.

Untoward Action.—Very frequently there appears, especially in children, an erythematous or scarlatinal eruption, oftener noticeable on the face and neck, but sometimes affecting the entire surface of the body. Redness and pain in the throat may also be present, but no fever, with itching of the skin or desquamation.

Occasionally instillation of atropine into the eye produces profuse lacrimation, edema of the eyelids, and blepharo-conjunctival irritation.

When taken internally in medicinal doses it sometimes occasions in certain persons vertigo, turgescence of the face, hallucinations, erethistic debility, and impaired assimilation.

Homatropine has caused dizziness, uncertainty of gait, fatigue, difficulty in deglutition, and loquacious delirium.

Poisoning.—The poisonous actions of belladonna may be summarized as follows:

The skin is dry and hot; the conjunctivæ are congested, with, possibly, edema of the eyelids, and pupils widely dilated; the heart action becomes rapid after ten to fifteen minutes; the face is swollen, while the whole body may be covered with an erythematous rash, and there is a sensation of heat and pain in the throat and difficulty in swallowing. These symptoms usually develop in from fifteen to twenty minutes.

Rapid respirations, muscular weakness, and incoördination of movements appear; the patient becomes dizzy or mildly or violently delirious, continually talking, shouting, or laughing. While there is a constant desire to micturate, there is an inability to pass any urine. At this stage the respirations are slow and shallow. Finally, convulsions may occur, and the patient sink into a comatose condition and die from asphyxia and cardiac exhaustion.

A lethal dose of atropine has been for an adult 0.15 gm. (2.5 grs.) and for a three-year-old child 0.01 gm. ($\frac{1}{6}$ gr.). The mortality

is not high, being stated by Kionka to be about 11.6 per cent. This was the figure of Feddersen in his dissertation study (Berlin) of 103 reported cases from 1880 to 1882. It is of interest to note that a fatal case is reported from the application of a plaster containing 0.18 gm. of atropine to 8 gm. fat (3 gr.). In fatal cases death takes place in from six to eight hours, sometimes as late as eighteen to twenty hours.

Treatment of Poisoning.—Wash out the stomach with solutions of tannic acid, pursuing the treatment with the cautious administration of physostigmine, morphine, or small doses of pilocarpine. Should cardiac failure be pronounced or the patient lapse into a state of stupor, stimulants and the subcutaneous injection of caffeine are indicated, the patient being aroused meanwhile and kept awake, if possible, respiration being maintained by the use of strychnine and by artificial means when necessary. Should the temperature fall below normal, external heat must be applied. It is usually advisable to empty the bladder by means of a catheter.

Atropine Compared with Morphine.

Atropine stimulates respiration; morphine is a powerful respiratory depressant. Atropine dilates the pupil; morphine contracts it. Atropine increases bodily heat, and frequently reddens the surface of the skin; morphine produces pallor of the skin and lowers temperature.

Both drugs lessen peristaltic action of the bowels in moderate doses. Atropine reinforces the functional activity of the kidneys; morphine lessens it. On the other hand, atropine checks the secretion from the skin, while morphine increases it.

The remaining secretions are diminished by both drugs, but in different ways.

Atropine acts rather as a cerebral excitant, producing delirium, hallucinations, and disturbed sleep; morphine is more of a cerebral depressant, the period of mental excitation being comparatively brief, while sleep is longer and more profound.

In many respects these drugs are mutually synergistic. Both relieve pain, though morphine is much the more powerful anodyne. Both cause incoördination of muscular movements and mental confusion.

Although in many respects antagonistic, they are frequently combined when an anodyne action is desired. As has been forcibly suggested, their reciprocal influence, when administered together, modifies in a remarkable manner their physiological effects.

Therapeutics.—The many uses for which belladonna has been employed would render it a difficult, perhaps useless, task to enumerate them. As in the case of opium, there are certain general and important actions in disease which the physican can utilize in daily practice, a succinct mention of which is appended:

1. Belladonna is serviceable in relaxing spasms of invol-

UNTARY MUSCLES, as in *asthma, spasmodic colic, lead colic, spasmodic dysmenorrhea, laryngismus stridulus*, etc.

2. In DIMINISHING SECRETION, as in *acute coryza, bronchitis, night-sweats of phthisis*, and to check the *secretion of milk, mercurial ptyalism*, etc.

3. In RELIEVING PAIN, either combined with opium or morphine, or alone, particularly where it can be applied locally, as in *lumbago, neuralgia, pleurodynia*, etc.

4. Belladonna is used to STIMULATE THE CIRCULATORY SYSTEM in cases of a weak heart and low arterial tension, as in *fevers*, etc.

5. For ITS PECULIAR ACTION UPON THE EYE IN OPHTHALMOLOGICAL PRACTICE, to dilate the pupil, prevent adhesion, remove congestion, relieve pain, and afford rest.

While, as has been said, it is impossible to discuss in detail the manifold uses of belladonna, its more important therapeutic services may be here mentioned:

Externally and Locally.—Belladonna ointment is useful in the treatment of *boils, carbuncles, chronic inflammatory conditions about the articulations, chronic synovitis of the knee-joint*, its efficiency in the latter condition being enhanced by combining it with mercurial ointment. *Orchitis* is greatly relieved by covering the testicle with belladonna ointment. Suppositories containing extract of belladonna are beneficial in the treatment of *hemorrhoids*, and in *anal fissure*.

Eczema and excessive sweating of certain areas of the skin, such as the palms and soles, are benefited by a local application of the tincture or the dried and powdered extract mixed with some inert desiccant powder like powdered talcum.

Belladonna plaster is one of the most useful applications in cases of *acute* or *chronic muscular rheumatic pains*, and in forms of *neuralgia*. In its power to arrest the secretion of milk the drug is perhaps without an equal.

Internally.—Belladonna is combined with opium to relieve the pain of *gastralgia* and *enteralgia*, while its combination with strychnine and iron is useful in *anemic neuralgia*.

Nocturnal incontinence of urine in children, when resulting from supersensitiveness of the mucous membrane of the bladder, derives signal benefit from the drug.

Belladonna combined with strychnine stimulates the respiration and checks the *sweating in phthisis*. A similar union with some laxative drug makes an exceedingly useful pill in *habitual constipation*, while the *obstinate constipation due to lead-poisoning* is greatly relieved by belladonna.

This drug, as well as the other mydriatic narcotics, is one of the most reliable remedies we possess to relieve the symptoms of *spasmodic asthma*. It is highly recommended also by many physicians in *typhoid fever* to support the circulation and relieve many distressing symptions of the disease. In *scarlatina*, too, it is thought to be a useful remedy. It is useful in *whooping-cough*.

Cardiac pain and distress due to over-action of the heart are alleviated by the application of belladonna plaster over the cardiac region or by the internal use of the drug.

Intestinal, *hepatic*, and *renal colic*, *cystitis*, *prostatitis*, *spermatorrhea*, *exophthalmic goiter*, *cerebral* and *spinal hyperemia*, *sea-sickness*, *facial erysipelas*, and *menorrhagia* have all apparently been favorably influenced by belladonna.

Atropine subcutaneously injected is a powerful antidote to *chloroform-*, *physostigma-*, *morphine-*, *aconite-*, and *jaborandi-poisoning*, as well as that contracted from muscarine or phallin containing mushrooms.

Administration.—The crude drug, leaves, and root are seldom if ever used. Owing to its action in diminishing secretion, it is better to time the internal adminstration of belladonna so as to interfere as little as possible with the process of digestion.

Atropine is more certain in its action than any of the preparations of the crude drug. In all cases it is best to administer atropine by the intensive method. A granule containing gr. $\frac{1}{1000}$ may be given to an adult, best in solution, every twenty to thirty minutes, according to the urgency of the case, until the first evidence of action is manifest. This is almost invariably dryness of the mouth; only exceptionally do any of the classic symptoms precede this. When this dryness is felt it is time to stop the drug. Children are peculiarly insusceptible to this drug, sometimes tolerating as large doses of the tincture as adults.

When atropine is used hypodermically in cases of sciatica or neuralgia, the injection should be made deeply in close proximity to the affected nerve-trunk.

The part of the body to which a belladonna plaster is to be applied should be first thoroughly cleansed and dried, the exact area to be covered being specifically designated by the physician. Caution should be exercised in the application, lest too large a space be covered by the plaster, and dangerous symptoms supervene from absorption of its more active constituents, a result which may also occur from too prolonged contact, from three to five days being usually sufficient. Should it be desirable to continue the influence of the drug, the application of fresh plaster from time to time will produce better results than too long use of a single one.

Hyoscȳamus—Hyoscȳami—Hyoscyamus. *U. S. P.*

(Henbane.)

Origin.—The dried leaves and flowering tops of *Hyoscyamus niger* L., collected from plants of the second year's growth, and yielding, when assayed, not less than .08 per cent. of mydriatic alkaloids. Henbane is a biennial growing in sandy soil and waste places throughout the greater portion of Europe and Asia, and naturalized in North America.

Description and Properties.—Leaves ovate or obovate-oblong, up to 10 inches (25 Cm.) long and 4 inches (10 Cm.) broad; sinuate-toothed, the teeth large, oblong, or triangular; grayish green, and, particularly on the lower surface, glandular-

hairy; midrib prominent; flowers nearly sessile, with an urn-shaped, five-toothed calyx and a light-yellow, purple-veined corolla; odor heavy, narcotic; taste bitter and somewhat acrid.

The active constituents are *hyoscyamine* and *hyoscine* (scopolamine), and a very poisonous volatile oil is obtained by distillation of the leaves, which contain also a small percentage of potassium nitrate. It is important to bear in mind that the modern hyoscyamine is distinct from the impure mixture of hyoscine and hyoscyamine previously designated hyoscyamines.

Dose of the Leaves.—5–15 grains (0.3–1.0 Gm.) [4 grains (.250 Gm.), U. S. P.].

Official Preparations.

Extrăctum Hyoscȳami—Extrăcti Hyoscȳami—Extract of Hyoscyamus.—*Dose*, 1–3 grains (0.06–0.2 Gm.) [1 grain (0.065 Gm.), U. S. P.].

Fluidextrăctum Hyoscȳami—Fluidextrăcti Hyoscȳami—Fluidextract of Hyoscyamus.—*Dose*, 5–15 minims (0.3–1.0 Cc.) [3 minims (0.2 Cc.), U. S. P.].

Tinctūra Hyoscȳami—Tinctūræ Hyoscȳami—Tincture of Hyoscyamus (10 per cent.).—*Dose*, 10–60 minims (0.6–4.0 Cc.) [30 minims (2 Cc.), U. S. P.].

Hyoscīnæ Hydrobrōmidum—Hyoscīnæ Hydrobrōmidi—Hyoscine Hydrobromide (U. S. P.).—*Origin.*—The hydrobromide of an alkaloid, chemically identical with scopolamine, obtained from hyoscyamus and other plants of the *Solanaceæ.*

Description and Properties.—Colorless, transparent, rhombic crystals, odorless, and having an acrid, slightly bitter taste; permanent in the air. Soluble in 1.5 parts of water and in 16 parts of alcohol at 25° C. It should be kept in small, well-stoppered vials.

Dose.—$\frac{1}{100}$–$\frac{1}{60}$ grain (0.0006–0.001 Gm.) [$\frac{1}{128}$ grain (.0005 Gm.), U. S. P.].

Hyoscyamīnæ Hydrobrōmidum—Hyoscyamīnæ Hydrobrōmidi—Hyoscyamine Hydrobromide (U. S. P.).—*Origin.*—The hydrobromide of an alkaloid obtained from hyoscyamus and other plants of the *Solanaceæ.*

Description and Properties.—Yellowish-white, amorphous, resin-like masses or prismatic crystals, having, particularly when damp, a tobacco-like odor and an acrid, nauseous, and bitter taste. Deliquescent on exposure to the air; soluble in about 0.3 part of water and 2 parts of alcohol. It should be kept in small, well-stoppered vials.

Dose.—$\frac{1}{100}$–$\frac{1}{40}$ grain (0.0006–0.0015 Gm.) [$\frac{1}{128}$ grain (.0005 Gm.), U. S. P.].

Hyoscyamīnæ Sŭlphas—Hyoscyamīnæ Sulphătis—Hyoscyamine Sulphate (U. S. P.).—*Origin.*—The neutral sulphate of an alkaloid obtained from hyoscyamus and other plants of the *Solanaceæ.*

Description and Properties.—White, indistinct crystals or a white powder, without odor, and of a bitter, acrid taste; deliquescent in damp air. Soluble in 0.5 part of water and 6.4 parts of alcohol at 25° C. It should be kept in small, well-stoppered bottles.

Dose.—$\frac{1}{100}$–$\frac{1}{40}$ grain (0.0006–0.0015 Gm.) [$\frac{1}{128}$ grain (.0005 Gm.), U. S. P.].

Scopŏla—Scopŏlæ—Scopola. *U. S. P.*

Definition.—The dried rhizome of *Scopola Carniolica,* Jacquin. Scopola is closely related to belladonna and hyoscyamus.

The Pharmacopœia demands that the drug contain not less than 0.5 per cent. of alkaloids; it is assayed by the same process as are belladonna leaves.

Dose.—Average dose: 0.045 Gm. = 45 milligrammes (¾ grain). U. S. P.

The alkaloid of scopola is almost wholly hyoscine. The content of the alkaloids of scopola is remarkably uniform (about 0.55 per cent.), whereas the percentage of alkaloids in belladonna varies from 0.2 to above 1 per cent.

Official Preparations.

Scopolamīnæ Hydrobrōmidum—Scopolamīnæ Hydrobrōmidi—Scopolamine Hydrobromide (U. S. P.).—*Definition.*—The hydrobromide of an alkaloid, $C_{17}H_{21}$-$NO_4HBr + 3H_2O$, obtained from plants of the *Solanaceæ;* chemically identical with hyoscine hydrobromide.

Although hyoscine hydrobromide, which was admitted into the U. S. Pharmacopœia, 1890, and scopolamine hydrobromide are identical, both names are used in the U. S. Pharmacopœia, Eighth Decennial Revision, as separate headings, because physicians are

more familiar with the name hyoscine than with scopolamine. Scopolamine is formed by the union of tropic acid and scopoline, a compound similar to tropine. (See Homatropine.)

Dose.—Average dose: $\frac{1}{128}$ grain (0.0005 Gm. = 0.5 milligramme). U. S. P.

Extrăctum Scopŏlæ—Extrăcti Scopŏlæ—Extract of Scopola (U. S. P.).—The U. S. Pharmacopœia demands that the extract of scopola contain 2 per cent. of mydriatic alkaloids; for method of assay see Pharmacopœia.

Dose.—Average dose: $\frac{1}{6}$ grain (0.010 Gm. = 10 milligrammes), U. S. P.

Fluidextrăctum Scopŏlæ—Fluidextrăcti Scopŏlæ—Fluidextract of Scopola (U. S. P.).—Prepared from scopola (*q. v.*) and containing 0.5 per cent. of the mydriatic alkaloids of this drug.

Dose.—Average dose: 1 minim (0.05 Cc.), U. S. P. This dose contains $\frac{1}{256}$ grain (0.00025 Gm.) of the scopola alkaloids.

Antagonists, incompatibles, and **synergists** the same as for belladonna.

Physiological Action.—The action of hyoscyamine is analogous to that of belladonna, with the following difference: (1) It shows more cerebral depression, as a rule, than does atropine. Excitement is, however, by no means infrequent.

(2) Pure hyoscyamine is thought to act more strongly on the heart, pupils, and sweat glands than atropine. Others deny this. According to Merck, there is absolutely no difference between atropine and hyoscyamine. Cushny says that while the resemblance is very close, there are differences. The consensus of clinical experience, however, seems to be that, while hyoscyamine closely resembles atropine, the former is milder in action.

(3) As for hyoscine (scopolamine), the action is quite different. Hyoscine is a distinct hypnotic. It depresses the cerebrum. Whether this depression is analogous to the depression of atropine with a very slight or no preliminary stimulation is not yet known. It is not improbable that hyoscine may be regarded as causing a more profound coma with less of the other effects of atropine. In its action on the peripheral nervous system it very closely resembles atropine in its action, being perhaps more powerful. Profound collapse has occurred from its use in disease with rapid and feeble pulse. The action in the medulla does not seem to be as stimulating as is that of atropine.

Untoward action, *poisoning*, and *treatment of poisoning* are the same as for belladonna.

Therapeutics.—HYOSCYAMUS may be used for the same purposes as belladonna, but is considered superior to the latter drug as a urinary sedative in the treatment of *incontinence of urine*, *vesical tenesmus*, *cystitis*, *prostatitis*, etc.

For the relief of *colic of various forms*, and to *allay the griping* produced by certain purgatives, hyoscyamus is better than belladonna.

In mental disorders it is useful in any maniacal state. In convulsive disorders, *hysterical convulsions*, *chorea*, *paralysis agitans*, etc., hyoscine is valuable. It has been recently advocated as a hypnotic in the treatment of the *morphine habit*.

Hyoscyamine has been found useful in aggressive *mania*, chronic

forms with hallucinations, subacute and recurrent mania, the irritative stages of *general paralysis*, and in *epilepsy*.

Hyoscyamus and its alkaloids are fully equal to belladonna in the treatment of *asthma*, *whooping cough*, *neuralgia*, *enteralgia*, etc.

As an anodyne and hypnotic for children hyoscyamus is frequently used. Hyoscine and morphine have recently been used extensively as an anesthetic. Morphine—gr. $\frac{1}{8}$ (0.008 Gm.) to gr. $\frac{1}{4}$ (0.015 Gm.)—with hyoscine—gr. $\frac{1}{100}$ (0.0006 Gm.)—is injected hypodermically, repeated in half or one hour if necessary, and again, when usually even a capital operation may be performed painlessly, or with the aid of the merest whiff of chloroform. This method of securing anesthesia is being widely tested and rapidly coming into favor in obstetrical practice.

Administration.—Like belladonna, this drug should be administered tentatively. Any of the preparations may be given. The salts of the alkaloids may be administered either subcutaneously or internally.

The hyoscine is tasteless, and may be easily given in various drinks. When used internally its action is slower, but more prolonged, than when given hypodermically, though the dose under the former method should be twice that of the latter.

Stramōnium—Stramōnii—Stramonium. *U. S. P.*

(THORN-APPLE; JAMESTOWN OR JIMSON WEED.)

Definition.—The dried leaves of *Datura Stramonium* L., yielding when assayed not less than 0.35 per cent. of mydriatic alkaloids. Stramonium is a coarse-looking annual weed, believed to be a native of Asia, but found growing in waste places and along roadsides throughout the greater part of the world.

Description and Properties.—From 3 to 8 inches (7–20 Cm.) long, petiolate, dark-green, smooth, ovate, pointed, unequal, especially at the base, coarsely and sinuately toothed; thin, brittle, and nearly inodorous; taste unpleasant, bitter, and nauseous. Stramonium leaves contain about 0.2 per cent. of a mixture of atropine and hyoscyamine previously termed *daturine*.

Dose.—1–5 grains (0.06–0.3 Gm.).

Antagonists, incompatibles, and **synergists** are the same as for belladonna.

Physiological Action.—The action of stramonium is practically identical with that of belladonna. It is thought to contain larger amounts of hyoscyamine than belladonna, and will, therefore, have more of the action of that drug combined with the action of atropine.

Poisoning from the thorn apple is by no means uncommon. It is a ubiquitous weed, widely dispersed, and its seeds are frequently eaten by children. The *treatment* should follow the lines established for belladonna-poisoning.

Therapeutics.—The medical uses of belladonna are applicable to this drug, although stramonium is much more widely used in *spasmodic asthma*.

Administration.—No special directions are necessary, any of the preparations being serviceable. For *asthma* the leaves may be

smoked in a pipe or in the form of cigarettes, this method of employing the drug to relieve bronchial spasm being probably superior to internal administration.

MOTOR DEPRESSANTS.

The more classic of these motor depressants is curare, but conium, because of its more extended use in therapy, will be first considered. *Gelsemium*, a third member of the group, may be said in a general way to pertain to both the atropine-cocaine and the curare groups, as it shows characteristic reactions of both.

A large number of drugs may be spoken of as motor depressants—thus, the entire alcohol group reduce motor power, and many others, nicotine, aconite, etc., but it is preferred to group here only those in which the principal medical uses are to depress the motor mechanism and lessen reflex excitability.

Conīum—Conīi—Conium. *U. S. P.*

(SPOTTED HEMLOCK.)

Origin.—The full-grown but unripe fruit of *Conium maculatum* L., carefully dried and preserved, and yielding when assayed not less than 0.5 per cent. of coniine. After being kept for more than two years conium is unfit for use. Spotted hemlock is a biennial indigenous herb, a few feet high, growing in the temperate regions of Asia, Europe, and Northern Africa, and naturalized in some portions of New England, New York, and South America. It grows in waste places and along streams.

Description and Properties.—About ⅛ inch (3 Mm.) long, broadly ovate, laterally compressed, grayish-green, often divided into two mericarps, each with five crenate ribs, without oil-tubes, and containing a seed grooved on the face; odor and taste slight.

When triturated with solution of potassium or sodium hydrate conium gives off a strong, disagreeable, mouse-like odor.

The most important constituent is a volatile liquid alkaloid, *coniine*. It also contains methyl-coniine, conhydrine, and its isomer pseudo-conine. The volatility of the alkaloid is largely responsible for the varying composition of the preparations and the discordant therapeutic results.

Dose.—1–5 grains (0.06–0.3 Gm. [3 grains (2 Gm.), U. S. P.].

Official Preparation.

Flūidextrăctum Conīi—Flūidextrăcti Conīi—Fluidextract of Conium.—*Dose*, 1–5 minims (0.06–0.3 Cc.) [3 minims (0.2 Cc.), U. S. P.].

Coniine is closely related to piperidine; its structural formula is that of propyl piperidine.

Antagonists and Incompatibles.—Nux vomica and its alkaloids, cocculus and picrotoxin, are antagonistic to conium. Tannic acid and the alkalies are chemically incompatible.

Synergists.—The motor depressants and morphine.

Physiological Action.—*Externally and Locally.*—Coniine, the active principle of conium, has no effect upon the unbroken skin.

Internally.—Digestive System.—Conium increases the salivary secretion, and when taken into the stomach exerts no special action upon the digestive system other than an occasional disturbance of the gastro-intestinal tract, possibly resulting in vomiting and diarrhea under full dosage.

Circulatory System.—Although when ingested coniine is rapidly absorbed by the blood, circulating in the system unchanged, its action is not clearly defined, though it has been held that the circulation is first accelerated and then retarded, with a lowering of arterial pressure preceded by a decided increase.

From its capacity to paralyze the vagi terminals it is natural to suppose that it increases the rapidity of the cardiac movements, yet a characteristic feature of the absorption of coniine is the apparent absence of cardiac derangement, the heart, as well as the mind, remaining unaffected in the presence of alarming symptoms.

Nervous System.—The action of coniine in the higher cerebral centers is very slight. In some patients a mild drowsiness has been observed, but, as a rule, consciousness and the thought processes are not modified, save in the final stages of asphyxiation. The action on the medulla is also slight.

Spinal Cord and Motor Ganglia.—The action on the cord is not determined. Slight twitchings and even convulsions are sometimes observed, but it is not positive that central irritation is the cause.

The characteristic action of conium is on the terminal end-plates in the voluntary muscles. These are paralyzed after a possible transitory stimulation. Some depression of motor-plates in involuntary muscles is also noted, particularly in the heart, but it is not as pronounced as in the plates of the voluntary muscles.

Respiratory System.—Large or poisonous doses may depress the respiratory center, but paralysis of the muscles of respiration is probably responsible for death rather than poisoning of the centers.

Absorption and Elimination.—The drug is readily absorbed. Elimination is rapid and takes place chiefly through the kidneys and lungs. Coniine has been detected in considerable quantities in the liver, lungs, and spleen.

Temperature.—It has been held that bodily temperature is perceptibly lowered by conium, proportionately with the extent of the paralysis occasioned. High authorities, however, assert an increase of temperature under both therapeutic and toxic doses.

Eye.—Heaviness of the eyelids, dilated pupils, accompanied by double or confused vision and occasionally entire loss of sight, have been noted among the symptoms incident to the administration of active dosage. The paralysis of the third nerve is probably responsible.

Poisoning.—A frequent symptom of conium-poisoning is ptosis, arising from paralysis of the oculomotor nerves. Staggering gait, general muscular relaxation, impairment of vision, nausea, and ver-

tigo are also not infrequent. The severer symptoms are marked by muscular paralysis of the extremities, derangement of vocal organs resulting in difficulty of speech, and dilatation of the pupils. The brain meanwhile remains unaffected until overcome by the accumulation of carbon dioxide gas in the blood, when delirium and coma may ensue, and finally cerebral convulsions and fatal collapse through respiratory failure. Doses of 2 gr. (0.15 gm.) conium have caused death within a half hour. Socrates is said to have died in 40 minutes after taking the poisoned cup.

Treatment of Poisoning.—The stomach should be evacuated by means of emetics or lavage, after which tannic acid and the physiological antidotes may be administered. Artificial respiration is practically the only expedient, as the paralyzed end-organs cannot physiologically respond to any drug irritation.

Therapeutics.—*Externally and Locally.*—Conium leaves applied as a poultice relieve pain somewhat, as in ulcers and carcinoma, but other and better local analgesics are at hand, and its use in this respect is limited.

It is very problematic whether conium has any well-marked therapeutic applications. If it is employed, it is absolutely essential that a very fresh specimen be used, since the active alkaloid is volatile. It is perhaps best to use a salt of the alkaloid or a salt of methyl-coniine. On theoretical, as well as practical, grounds it can have little value in the involuntary spasmodic affections; it can only mask muscular movement, not modify the pathological impulses. In voluntary habit spasms, however, it has its only practical uses. Here it may prevent the accomplishment of a morbid muscle impulse, and thus with suggestive therapeutics be of service in the treatment of the habit "tics," habit spasms, etc., particularly in their early stages. When the brain path is firmly established conium is of little service.

Contraindications.—Conium should not be given to persons suffering from great exhaustion and debility or from diseases interfering with the rhythm of the heart.

Administration.—The preparations of conium are very unreliable, the assayed, or "standardized" fluid extract being perhaps the one to be depended upon most uniformly. Owing to the uncertainty of their strength, the administration should begin with small doses gradually augmented until interference with involuntary motion is observed, when further increase should be stopped.

The effects of the drug are weakened by repeated doses, rendering an increase in the dose necessary from time to time. Coniine and morphine greatly aid each other, and this combination is a particularly efficient one in the treatment of painful muscular spasms and acute mania with excessive motor activity. Conium and sulphonal are of great value in insomnia accompanied by motor restlessness. (See Sulphonal.)

Curāre—Curāre—Curare (*unofficial*).

(WOORARI.)

Origin.—An extract of uncertain composition prepared by the natives of South America as an arrow-poison. Dr. Jobert reported to the French Academy in 1878 that the poison was prepared chiefly from *Strychnos Castelnæana* and other species of *Strychnos*, and *Cocculus toxiferus*, containing also variable quantities of other poisonous plants, such as *Didelphys cancrivora*, etc. It is altogether probable that its ingredients include the poison of venomous reptiles. Each tribe, however, has its own method for preparing curare, and the precise formulas are clan secrets. Bŏhm's studies in 1887 were among the first to give accurate details of the varieties, but these change from time to time.

Description and Properties.—The extract is a blackish-brown, friable solid, brittle or hygroscopic, of a very bitter taste; almost completely soluble in dilute alcohol. Cold water dissolves about 75 per cent., which portion contains the poisonous alkaloids and is insoluble in ether and but sparingly soluble in absolute alcohol.

The active constituents vary somewhat. *Curarine* is the name given by Bŏhm to the alkaloid, or impure nitrogenous base, which produces the typical paralyzing effects of curare. Other alkaloids have been named *curin* and *protocurarine*, the former inert, the latter supposed to be very active. Bŏhm's studies have not been subjected to careful revision.

Dose.—$\frac{1}{20}$–$\frac{1}{2}$ grain (0.003–0.03 Gm.), hypodermically given.

Dose of Curarine.—$\frac{1}{200}$–$\frac{1}{100}$ grain (0.0003–0.0006 Gm.), hypodermically.

Antagonists and Incompatibles.—The excito-motors are antagonistic. Tannic acid and the caustic alkalies are chemically incompatible.

Synergists.—The depresso-motors.

Physiological Action.—When applied to the denuded skin it is an irritant.

Circulatory System.—Medicinal doses render the pulse fuller and rapid from vagus depression; there is marked dilatation of the blood-vessels of the skin and the various glands; while the blood-pressure, though little affected by small doses, is decidedly lowered by large ones. The ganglionic paresis causes the fall in pressure.

Nervous System.—No cerebral action is caused by moderate doses. The action on the medulla is slight in moderate dosage.

Spinal Cord and Peripheral Nerves.—The typical action of curare is on the end-plates of the motor nerves of striated muscles. These are paralyzed, the smaller muscles being first involved, hence ptosis, etc. The respiratory muscles are first acted on. Unstriped muscle terminations are not affected. Sensory nerves are unaffected. The peripheral ganglia of the sympathetic are paralyzed. The dilated pupil, the increased peristalsis, and involuntary evacuations are indications of this sympathetic nerve depression.

Respiratory System.—Curare is a powerful respiratory depressant, paralyzing the ends of the motor nerves distributed to the respiratory muscles. When lethal doses have been given, the paralysis may become central. Death results from asphyxia.

Curare is absorbed very slowly from the stomach and is probably little acted on in the body, as in animals most of it has been recovered from the urine.

Absorption and Elimination.—When ingested the process of

absorption is exceedingly slow, but when injected into the circulation the drug is rapidly absorbed.

It is quickly eliminated by the kidneys, causing sugar to appear in the urine. A portion of the poison is also excreted with the feces. The sweat, saliva, nasal mucus, and tears, although their secretion is greatly increased by the drug, do not seem to share in the process of elimination. Metabolism in general is checked.

Poisoning.—Curare is a rapid and active poison. The movements of the heart are greatly accelerated; the pulse is weak and dicrotic; the temperature is elevated, and the respiration correspondingly depressed; extreme muscular weakness ensues, with incoördination of movements; the urine becomes saccharine. Finally, paralysis of the extremities and the respiratory muscles supervenes, death occurring from respiratory paralysis.

Treatment of Poisoning.—The same as in the treatment of poisoning from conium, with catheterization of the bladder to favor elimination, and artificial respiration.

Therapeutics.—While of great scientific interest and of value for experimental purposes in ascertaining the effect of certain drugs upon animals, the therapeutic uses of curare are very limited. It is indicated only in those diseases for which conium has proved of some service.

Contraindications.—The same as for conium.

Administration.—The crude drug or the alkaloid *curare* should be given hypodermically.

Gelsēmium—Gelsēmii—Gelsemium. *U. S. P.*

(Yellow Jasmine.)

Origin.—The dried rhizome and roots of *Gelsemium sempervirens* (L.) Pers., a plant indigenous in the southern United States, growing in moist woods.

Description and Properties.—Cylindrical, long or cut in sections about 1 inch (25 Mm.) in length, externally light-yellowish brown, with purplish-brown longitudinal lines; tough, fracture splintery; bark thin, with silky bast-fibers closely adhering to the pale-yellowish, porous wood, which has five medullary rays, and in the rhizome a thin pith; odor aromatic, heavy; taste bitter.

It contains two alkaloids, *gelsemine*, with an action on frogs resembling strychnine, and *gelseminine*, which acts more like coniine. The general effects are therefore blended, but gelseminine is the more potent alkaloid, for man at least.

Dose.—2–10 grains (0.13–0.6 Gm.) [1 grain (0.065 Gm.), U. S. P.].

Official Preparations.

Flŭidextrăctum Gelsēmii—Flŭidextrăcti Gelsēmii—Fluidextract of Gelsemium.—*Dose,* 2–10 minims (0.12–0.6 Cc.) [1 minim (0.05 Cc.), U. S. P.].

Tinctūra Gelsēmii—Tinctūræ Gelsēmii—Tincture of Gelsemium.—*Dose,* 15–60 minims (1.0–4.0 Cc.) [8 minims (0.5 Cc.), U. S. P.].

Gelsemīna (unofficial)—**Gelsemīnæ—Gelsemine.**—*Description and Properties.*—A brittle, solid, transparent, crystallizable mass, converted into a colorless liquid at 45° C. (113° F.). Insoluble in cold water, but soluble to a slight extent in hot water, as well as in alcohol; taste bitter.

Dose.—$\frac{1}{200}$–$\frac{1}{40}$ grain (0.0003–0.001 Gm.).

Antagonists and Incompatibles.—The cardiac and diffusible stimulants are antagonistic; tannic acid and caustic alkalies are incompatible, precipitating the alkaloid.

Synergists.—The motor depressants.

Physiological Action.—The action of gelsemium throughout resembles that of conium and curare very closely. There are certain points of difference, however, that render this drug much more valuable therapeutically than either of the others.

On the cerebrum, gelsemium shows a more pronounced depressing action, causing drowsiness and depression. As this is often a late symptom with large doses it may be due to beginning asphyxiation.

Gelsemium depresses the respiratory center more than does curare. It also has a classical peripheral action.

Gelsemium has a distinct action on sensory nerves. It is, therefore, useful in painful affections.

The heart action under medicinal doses of gelsemium is more apt to be slowed than quickened, as with the more powerful curare. This would seem to indicate less depression of the vagus. It has a pronounced effect on the sympathetic ganglia and is useful therapeutically in reducing blood-pressure.

Absorption and Elimination.—Gelsemium is speedily absorbed and readily excreted, chiefly by means of the kidneys. Untoward symptoms produced by immoderate amounts of the drug practically subside within three hours after ingestion.

Poisoning.—In toxic doses gelsemium is quickly fatal. The early symptoms include drooping of the eyelids, wide dilatation and immobility of the pupils, extreme muscular weakness, affecting first the muscles of the upper extremities, and incoördination of movements. Diplopia and dimness of vision may ensue, accompanied by difficulty of speech, coldness of the body surface, and general cutaneous anesthesia, with decidedly lower temperature. Meanwhile, there is marked diminution in the force of the heart and respiratory paralysis. Death has resulted from a teaspoonful of the fluid extract. $\frac{1}{6}$ gr. of gelseminine is given as a minimum lethal dose.

While the patient may be drowsy, the mind is unaffected until carbonic-acid narcosis supervenes. Death is usually the result of respiratory failure, due to paralysis of the muscles of respiration. Paralysis of the heart also occurs.

Treatment of Poisoning.—The evacuation of the stomach is of the first importance, either by the stomach-pump or by the use of emetics. Washing out with a solution of tannic acid is probably the best method to pursue. External heat should be applied and diffusible stimulants administered, followed by digitalis and strychnine. The hypodermic injection of morphine and atropine is highly recommended in gelsemium-poisoning. Artificial respiration is imperative.

Therapeutics.—*Externally and Locally.*—The drug is seldom used externally, although it has been employed by ophthalmologists as a mydriatic.

Internally.—Clinically, gelsemium is now considered less valuable than formerly. It has been favorably mentioned by certain authors in the treatment of *tetanus*, *mania* with motor excitement and *paralysis agitans*.

The drug appears to be more serviceable in *trifacial neuralgia*,

and it seems to be even more efficient in neuralgia with involvement of the inferior dental nerve. In these disorders, as in *ovarian neuralgia, dysmenorrhea*, etc., for which it has been employed with some success, the drug should be pushed to its physiological limit.

Bartholow praised the action of gelsemium in *cerebro-spinal meningitis* and "*acute inflammations of the lungs and pleura.*"

Bulkley is responsible for its use in *pruritus* and *eczema*, the itching of which it certainly appears to alleviate.

Contraindications.—Diseases accompanied by exhaustion and great muscular weakness.

Administration.—Any of the preparations may be given, the initial dose being small, and the amount increased gradually until dilatation of the pupil or drooping of the eyelids is manifest.

Physostĭgma—Physostĭgmatis—Physostigma. *U. S. P.*

(Calabar Bean.)

Origin.—The seed of *Physostigma venenosum* Balfour, a lofty, half-shrubby, climbing plant (somewhat resembling the scarlet runner or Spanish bean of our gardens), growing near the mouths of the Niger and Old Calabar Rivers in Western Africa, and attaining a height of 40 or 50 feet (12–15 M.).

Description and Properties.—The seeds are about 1 to 1¼ inches (25–30 Mm.) long, $\frac{5}{8}$ to $\frac{3}{4}$ inch (15–20 Mm.) broad, and $\frac{3}{8}$ to $\frac{5}{8}$ inch (10–15 Mm.) thick; oblong and somewhat reniform; testa granular, chocolate-brown, with a broad, black groove extending the entire length of the convex edge; embryo with a short, curved radicle and two large, white concavo-convexed cotyledons; inodorous; taste bean-like.

The drug contains an alkaloid, *physostigmine* (also known as *eserine*), which is the principal constituent; *calabarine*, to which the drug owes its tetanizing properties; and *eseridine* (a laxative and motor excitant); besides a neutral principle, *physosterin*, related to cholesterin.

Dose.—1–4 grains (0.065–0.25 Gm.) [1½ grains (0.1 Gm.), U. S. P.].

Official Preparations.

Extrăctum Physostĭgmatis—Extrăcti Physostĭgmatis—Extract of Physostigma.—*Dose*, $\frac{1}{16}$–$\frac{1}{6}$ grain (0.004–0.01 Gm.) [$\frac{1}{8}$ grain (0.005 Gm.), U. S. P.].

Tinctūra Physostĭgmatis—Tinctūræ Physostĭgmatis—Tincture of Physostigma.—*Dose*, 5–10 minims (0.3–0.6 Cc.) [15 minims (1 Cc.), U. S. P.].

The alkaloid, **physostigmine**, is not official. It occurs in colorless or slightly pinkish crystals; sparingly soluble in water; readily soluble in alcohol.

Dose.—$\frac{1}{100}$–$\frac{1}{20}$ grain (0.0006–0.003 Gm.). The salicylate and sulphate of physostigmine are official.

Physostigmīnæ Salĭcylas—Physostigmīnæ Salicylātis—Physostigmine Salicylate (Eserine Salicylate), U. S. P.

Description and Properties.—Colorless or faintly yellowish, shining, acicular, or short, columnar crystals, odorless, and of a bitter taste; acquiring a reddish tint when exposed to light and air; soluble in 150 parts of water and 12 parts of alcohol. The salicylate should be kept in small, dark amber-colored, and well-stoppered vials.

Dose.—$\frac{1}{120}$–$\frac{1}{30}$ grain (0.0005–0.002 Gm.) [$\frac{1}{64}$ grain (0.001 Gm.), U. S. P.].

Physostigmīnæ Sūlphas—Physostigmīnæ Sulphātis—Physostigmine Sulphate (Eserine Sulphate), U. S. P.

Description and Properties.—A white, or yellowish-white, micro-crystalline powder, odorless, and of a bitter taste. It is very deliquescent when exposed to moist air, gradually turning reddish in air and light. Very soluble in water and alcohol; still more so at the boiling-point of these liquids. It should be kept in small, dark amber-colored, and well-stoppered vials.

Dose.—$\frac{1}{120}$–$\frac{1}{30}$ grain (0.0005–0.002 Gm.) [$\frac{1}{64}$ grain (0.001 Gm.), U. S. P.].

Antagonists and Incompatibles.—The action of physostigma upon the heart, respiration, and pupils is antagonized by atropine; that on the spinal cord, by chloral; while, in a general way, the motor excitants, particularly the tetanizing agents, are therapeutically antagonistic.

The caustic alkalies and tannic acid are chemically incompatible.

Synergists.—The motor depressants.

Physiological Action.—*Externally and Locally.*—No external action of physostigma and its preparations is noted, unless it be its effect upon the pupil, which outward application contracts, and the slight abolition of functional activity in the motor and sensory nerves, occasioned, it is said, by a strong solution of physostigmine.

Internally.—*Digestive System.*—The administration of the drug tends to stimulate the salivary, gastric, and intestinal secretions, and, by acting upon the muscular coats of the stomach and intestines, to increase peristalsis. Nausea, retching, vomiting, and purging may result. The intestinal contractions set up are very powerful, so much so that physostigmine has been used as a remedy for intestinal paresis following abdominal operations.

Circulatory System.—No influence on the blood has been detected. Small doses increase arterial tension, the heart's action becoming slower and stronger.

Nervous System.—The higher cerebral centers are not primarily affected by this drug in man. The medulla and cord are the main structures involved. After a transient stimulation depression sets in, the spinal reflexes being abolished, and final poisoning of the medullary centers occurs.

Respiratory System.—Small doses stimulate respiration. Larger amounts primarily depress the respiratory centers, stimulate the peripheries of the pulmonary vagi, and contract the caliber of the bronchial tubes, even to the extent of serious constriction, death usually resulting from asphyxia.

The breathing is first quickened and then retarded, the effect of the drug upon the respiration being more powerful than its circulatory influence, the heart continuing to beat for some time after pulmonary action has ceased.

Although the effect upon the heart is somewhat obscure, it appears that under poisonous doses the cardiac pulsations are greatly reduced, being slow and feeble, and finally ceasing altogether. It is reasonably supposed that this action is due to primary stimulation of the peripheral vagi, influencing the cardiac ganglia, and also to the effect upon the vasomotor centers. The subsequent exhaustion and relaxation of the arteries are doubtless the result of a similar influence.

There is marked elevation of blood-pressure under moderate doses, although there may occur a brief period of depression. Toxic doses are accompanied by a notable decrease of arterial tension, the cardiac ganglia being seized with paralysis, and the heart finally arrested in diastole.

Secretions.—All of the secretions, notably the tears, sweat, saliva, mucous secretions, pancreas, and bile, are markedly augmented.

Temperature.—A slight depression has been noted.

Eye.—Applied locally to the conjunctiva or introduced into the circulation, whether by ingestion or injection, physostigmine causes myosis or contraction of the pupil by stimulating the peripheral endings of the oculomotor nerves, possibly by a depression of the sympathetic fibers.

Other prominent symptoms present are spasm of accommodation and decreased intra-ocular tension and myopia. Irritation of the third nerve is the principal cause of these phenomena. The intra-ocular pressure is lowered (1) by lessening the blood-supply to the eye through contraction of the blood-vessels; (2) by diminishing the secretion of the aqueous humor from the glands on the surface of the ciliary body; (3) by contracting the iris, so that the aqueous humor can more readily pass through the canal of Schlemm.

Unstriped Muscle.—The full influence of the drug tends to produce uterine contractions, and it also influences the unstriped muscles of the bladder, ureter, bronchi, as well as the intestines. to increased contractions.

Absorption and Elimination.—The active principles of physostigma and its alkaloids are rapidly diffused in the blood. They are largely excreted by the kidneys, the bile and saliva contributing to the process of elimination, and have been detected in the gastric juices after intravenous injection.

Untoward Action.—When eserine is applied to the eye it occasionally produces a nervous contractile pain in the entire eyeball, which extends in a manner similar to ciliary neurosis along the course of the supra-orbital nerve, resembling migraine.

Small doses have in some individuals produced nausea and general uneasiness, and occasionally intense pain in the epigastrium.

Poisoning.—Taken in poisonous doses, physostigma causes in from $\frac{1}{4}$–$\frac{1}{2}$ hour, occasionally 2 hours, nausea, giddiness, and muscular tremors and weakness, followed by complete muscular relaxation. There are muscular tremors and intense salivation, increased tear-flow, and profuse perspiration. Involuntary urination and defecation have been observed. Cardiac action is diminished; the reflexes are in abeyance; the respiration is retarded: and myosis and motor paralysis are manifest. The pupils visibly contract, and purging and vomiting may ensue. Fatal results are possible through paralysis of the respiratory center and consequent asphyxia. The more rapid collapse succeeding the administration of lethal doses is due to cardiac syncope.

Doses of 4–9 grains (0.3–0.6 Gm.) of the seed have caused serious symptoms. Physostigmine salicylate $\frac{3}{4}$ grain (0.05 Gm.) has resulted in severe poisoning with recovery.

Treatment of Poisoning.—The stomach should be evacuated, the process being followed by the hypodermic injection of a solution

of atropine, which may prove an efficient physiological antidote. Tannic acid may be used as a chemical antagonist. Diffusible stimulants, such as ether or ammonia, may serve to arrest cardiac and respiratory failure. Digitalis and alcohol have also been successfully employed. Temperature should be maintained by the application of external heat.

Therapeutics.—*Externally and Locally.*—PHYSOSTIGMINE and ESERINE SULPHATE are the preparations usually employed, their only action of importance being in *diseases of the eye.* They are of value in breaking up adhesions of the iris to the cornea or lens, strengthening the muscle of accommodation, reducing intra-ocular pressure, and removing the effects of atropine, although Jessup claims that *complete* ciliary paralysis by atropine and the mydriasis induced by hyoscine are unaffected by eserine.

In certain cases of *ulcer of the cornea* uncomplicated with iritis and sloughing keratitis, where there is little inflammation or ciliary irritation, eserine sometimes produces prompt improvement when atropine has failed.

Paralytic mydriasis and *paralysis of accommodation* are temporarily relieved by this drug, and weak solutions have been employed with varying success in accommodative *asthenopia* without refractive errors.

The remedy is of unquestioned value in the early stages of *glaucoma*, but only at the commencement of an acute attack and contra-indicated in the hemorrhagic form. If the drug fails to contract the pupil when used for glaucoma, it may induce irritating spasm of the ciliary muscles by increasing the blood-supply to the iris.

PHYSOSTIGMINE is sometimes employed to prevent *prolapsus of the iris*, following peripheral perforation of the cornea or cataract extraction, particularly without iridectomy.

The remedy serves a useful purpose also in coal-miners' *nystagmus*, 1 drop of a collyrium containing ½ grain (0.096 Gm.) of PHYSOSTIGMINE SULPHATE in 1 ounce (30.0 Cc.) of distilled water being dropped into the eye three times a day. Eserine is also employed in *neuralgia of the eyeball* and *photophobia.*

Internally.—PHYSOSTIGMA has proved efficacious in *constipation* due to an atonic condition of the intestines with deficient secretion. The state of the muscular intestinal layer frequently allows gas to accumulate in the bowels, with consequent troublesome *flatulence.* The drug, by imparting tone to the muscles and increasing peristalsis, greatly relieves this unpleasant condition. It is of inestimable value in the treatment of *intestinal paresis* following abdominal operations.

Gastric and *intestinal dilatation* have been successfully treated by Hare with this remedy. It is valuable in *chronic bronchitis* with dilatation of the bronchial tubes, and is said to relieve *bronchial asthma* and *emphysema.*

It has been recommended in tetanus and in general spasmodic disorders, but its efficacy is of questionable value.

Contraindications.—The same as for conium.

Administration.—The extract or the tincture is usually preferred for internal administration, although the alkaloid fully represents the drug and may be given either by the mouth or hypodermically. For application to the eye the salts of the alkaloid are used. A convenient form of physostigmine in ophthalmic practice is the medicated gelatin disks.

Grindēlia—Grindēliæ—Grindelia. *U. S. P.*

Origin.—The dried leaves and flowering tops of *Grindelia robusta* Nutt., and of *Grindelia squarrosa* Dunal, herbaceous or suffruticose perennials, indigenous in the western part of North America and Mexico.

Description and Properties.—Leaves about 2 inches (5 Cm.) long, varying from broadly spatulate or oblong to lanceolate, sessile or clasping, obtuse, more or less sharply serrate, often spinous-toothed or even laciniate-pinnatifid, pale-green, smooth, finely dotted, thickish, brittle; heads many-flowered, subglobular or somewhat conical, the involucre hemispherical, about ⅜ inch (10 Mm.) broad, composed of numerous imbricated, squarrose-tipped, or spreading scales; ray-florets yellow, ligulate, pistillate; disk-florets yellow, tubular, perfect; pappus consisting of two or three awns of the length of the disk-florets; odor balsamic; taste pungently aromatic and bitter.

The principal constituent is probably a resinous substance. It also contains an alkaloid principle, grindeline, and a volatile and a fixed oil.

Dose.—10–60 grains (0.6–4.0 Gm.) [30 grains (2 Gm.), U. S. P.].

Official Preparation.

Fluidextrăctum Grindēliæ—Fluidextrăcti Grindēliæ—Fluidextract of Grindelia.—*Dose*, 10–60 minims (0.6–3.7 Cc.) [30 minims (2 Cc.), U. S. P.].

Antagonists and Incompatibles.—Aqueous preparations, the caustic alkalies, and mineral salts are incompatible.

Synergists.—The motor depressants.

Physiological Action.—*Externally and Locally.*—The drug is sedative and mildly astringent.

Internally.—Digestive System.—When ingested it excites a sense of warmth in the epigastrium, and in moderate doses increases the secretion of the gastric juice, stimulating the appetite and improving digestion.

Circulatory System.—The heart is slowed by medicinal doses through stimulation of the inhibitory center. The blood-pressure, however, is raised and maintained by stimulation of the vasomotor center.

Nervous System.—Grindelia possesses considerable power as a depressant. Its effect upon the motor mechanism is to cause a pronounced muscular weakness affecting first the lower extremities. The sensory nerves are first depressed, there being quite marked cutaneous anesthesia. The drug depresses the reflex mechanism in the spinal cord, so that the reflex movements are greatly lessened.

Respiratory System.—Small doses have little effect upon the respiratory movements; large doses retard the breathing; while toxic doses may produce death through paralysis of the respiratory muscles.

The drug slightly increases the secretion from the pulmonary mucous membrane and relaxes the circular fibers of the bronchial

muscles. The ends of the sensory nerves distributed to the pulmonary mucous membrane are also depressed.

Absorption and Elimination.—Grindelia is readily absorbed, and is eliminated chiefly by the kidneys, increasing the urinary flow, the lungs sharing in the excretory process.

Temperature is unaffected.

Eye.—Large doses cause dilatation of the pupil.

Uterus.—No effect has been noticed.

Untoward Action.—Excepting drowsiness, reduction of cutaneous sensibility, slight gastric disturbance, and a feeling of weakness, no symptoms have been recorded.

Poisoning.—The drug is feebly toxic; excessive doses, however, act as a gastro-intestinal irritant. The patient is sleepy and complains of muscular weakness; there is a numb or anesthetic condition of the skin, while the pupils are dilated and the pulse and respiratory movements slow and feeble. Should death occur, it will be from paralysis of the muscles of respiration.

Treatment of Poisoning.—The same as in poisoning from conium —diffusible stimulants, strychnine, etc.

Therapeutics.—*Externally and Locally.*—Grindelia is a very efficient application to the skin in *rhus-poisoning*. Indeed, it serves as a soothing lotion in many acute inflammations of the skin, such as *eczema*, etc. The fluidextract used should be well diluted and applied on cloths.

Internally.—Grindelia has acquired an enviable reputation as a remedy for *spasmodic asthma*, its action upon the bronchial muscles rendering it singularly beneficial in this disorder. It acts to relax the spasm of the muscles. The drug has no influence, however, in preventing a recurrence of the paroxysms.

The drug has been highly recommended in *acute* and *chronic bronchitis*, *hay-fever*, *whooping-cough*, and in *spasmodic cough* of whatever nature. It has even been suggested as a palliative remedy in *pneumonia* and in cardiac and pulmonary *dyspnea*.

There are no special **contraindications** or directions for **administration**, save that the fluidextract is pharmaceutically incompatible with aqueous preparations.

Aspidospĕrma—Aspidospermātis—Aspidosperma (*unofficial*).

Origin.—The bark of *Aspidosperma Quebracho-blanco* Schlechtendal, a large evergreen tree of exceedingly hard wood (Sp. *quebar*, to break, and *hacha*, an axe), indigenous in the Argentine Republic.

Description and Properties.—Occurring in nearly flat pieces about ½ to 1¼ inches (12.0–30.0 Mm.) thick; the outer surface yellowish-gray or brownish, deeply fissured; inner surface yellowish-brown or reddish-brown, distinctly striate; fracture displaying two sharply defined strata of about equal thickness, both marked with numerous whitish dots and striæ arranged in tangential lines; the fracture of the outer lighter-colored layer rather coarsely granular, and that of the darker-colored inner layer short-splintery; inodorous; taste very bitter and slightly aromatic.

Six alkaloids have thus far been isolated from aspidosperma, the most important being *aspidospermine* and *quebrachine*, the former occurring in colorless prismatic crystals, insoluble in water and soluble in 48 parts of alcohol.

Dose.—5–30 grains (0.3–2.0 Gm.).

Preparations.

Fluidextrăctum Aspidospĕrmatis—Fluidextrăcti Aspidospĕrmatis—Fluidextract of Aspidosperma.—*Dose,* 5–30 minims (0.3–1.8 Cc.).
Aspidospĕrmine.—*Dose,* ¼–½ grain (0.016–0.03 Gm.).
Quebrăchine.—*Dose,* 1–2 grains (0.06–0.12 Gm.).

Physiological Action.—*Externally and Locally.*—No important action has been noted.

Internally.—*Digestive System.*—It is a stomachic, having an action analogous to the vegetable bitters.

Circulatory System.—Aspidosperma depresses the heart, rendering its action slower, with reduction of arterial tension.

Nervous System.—In its action it resembles conium. It depresses the motor mechanism by its influence on the motor centers, and lessens the reflexes through its influence on the spinal cord. Excessive doses cause vertigo and headache, together with paralysis of the extremities, the lower being first affected.

Respiratory System.—Medicinal amounts of aspidosperma retard the breathing, but deepen the inspirations; aspidospermine, on the contrary, increases the respiratory movements. Toxic doses paralyze the respiratory center, death resulting apparently from asphyxia and convulsions.

Absorption and Elimination.—It readily passes into the blood, and is excreted chiefly by the urine, the saliva and sweat sharing in the process of elimination.

Temperature.—It is antipyretic, febrile temperature being reduced by full doses of the drug.

Poisoning.—Aspidospermine is an active respiratory poison, the toxic symptoms being vertigo, headache, free diaphoresis and salivation, great muscular weakness, with paralysis of the lower extremities, slow and weak heart, reduction of temperature, marked depression of the respiration, and death from respiratory failure.

Treatment of Poisoning.—The same procedure is advisable as in cases of poisoning from the other motor depressants.

Therapeutics.—Aspidosperma is not employed locally, its chief value being in the treatment of *dyspnea* of whatever variety, though it is fair to state that Pluzoldt considers it contraindicated in cardiac dyspnea.

The drug is equal, if not superior, to grindelia in the treatment of *spasmodic disorders of the respiratory apparatus.*

By some clinicians it is claimed to be an efficient remedy in *pneumonia,* being especially useful in relieving cyanosis.

Aspidospermine has been highly recommended as an antiperiodic in malaria, and has appeared to modify the symptoms of *acute articular rheumatism.*

Administration.—Both the fluidextract and the alkaloid may be given internally, although a favorite and efficient method of administering the alkaloids is by hypodermic injection.

Sŭmbul—Sŭmbul—Sumbul. *U. S. P.*

Origin.—The dried root of an undetermined plant, probably of the family *Umbelliferæ*. It is thought by some to be *Ferula sumbul* (Kauffmann) Hooker fil, a perennial about 8 feet (2.4 M.) high, indigenous in regions north and east of British India.

Description and Properties.—It occurs in transverse segments, varying in diameter from 1 to 3 inches (2–7 Cm.), and in length from 6 to 12 inches (14–30 Cm.); light spongy, annulate or longitudinally wrinkled; bark thin, brown, more or less bristly fibrous; the interior whitish, with numerous brownish-yellow resin-dots and irregular, easily separated fibers; odor strong, musk-like; taste bitter and balsamic. It contains *sumbolic* and *valerianic acids*, a small quantity of volatile oil, and two balsamic resins, to which its odor is due.

Dose.—15–30 grains (1.0–2.0 Gm.) [30 grains (2 Gm.), U. S. P.].

Official Preparations.

Fluidextrăctum Sŭmbul—Fluidextrăcti Sŭmbul—Fluidextract of Sumbul. —*Dose*, average dose: 30 minims (2 Cc.).

Extrăctum Sŭmbul—Extrăcti Sŭmbul—Extract of Sumbul.—Prepared from the fluidextract of sumbul.

Dose.—Average dose: 4 grains (0.250 Gm. = 250 milligrammes).

Physiological Action.—See Antispasmodics (Valerian).

Therapeutics.—The drug is valuable in the various manifestations of *hysteria*, and has been employed with some success in *ovarian neuralgia* and *dysmenorrhea*.

It is similar to, though not so efficient as, grindelia in *spasmodic coughs*. Indeed, most of the disorders benefited by the antispasmodics yield to the influence of sumbul.

In *neurasthenia* with anemia the extract of sumbul, combined with iron and arsenic, serves a very useful purpose.

Vibŭrnum Prunifōlium—Vibŭrni Prunifōlii—Black Haw. *U. S. P.*

Origin.—The dried bark of *Viburnum prunifolium* L., a tall shrub or small tree, 10 to 20 feet (3–6 M.) high, growing in thickets throughout the greater portion of the United States east of the Mississippi.

Description and Properties.—Thin pieces or quills, glassy purplish-brown, with scattered warts and minute black dots; when collected from old wood, grayish-brown, the thin corky layer easily removed from the green layer; inner surface whitish, smooth; fracture short; inodorous; somewhat astringent and bitter.

It contains a bitter principle (viburnin), a bitter resin, valerianic acid, besides tannic, oxalic, citric, and malic acids.

Dose.—30–60 grains (2.0–4.0 Gm.) [30 grains (2 Gm.), U. S. P.].

Official Preparation.

Fluidextrăctum Vibŭrni Prunifōlii—Fluidextrăcti Vibŭrni Prunifōlii—Fluidextract of Black Haw.—*Dose*, ½–1 fluidram (1.8–3.7 Cc.).

Antagonists and Incompatibles.—It is chemically incompatible with iron and other substances affected by tannic acid.

Synergists.—Antispasmodics and uterine sedatives.

Physiological Action and Therapeutics.—The action of black haw is best understood by classing it with the volatile-oil group. It acts as an antispasmodic, diuretic, nervine, and tonic, being especially useful in various uterine disorders, such as *spasmodic* and *membranous dysmenorrhea*.

The various vasomotor disturbances and the *menorrhagia* inci-

dent to the menopause are frequently relieved by this remedy. It is also of some value in the *prevention of abortion.* Its sedative properties render it serviceable in relieving the severity of *after-pains.*

Viburnum Opulus—Viburni Opuli—Cramp Bark. *U. S. P.*

Origin.—The dried bark of *Viburnum opulus* L., a small tree 10 to 15 feet (3-4.5 M.) high, indigenous in Canada, the Northern United States, Europe, and Northern Asia.

Description and Properties.—Flattish or curved bands, or, occasionally, quills, sometimes 12 inches (30 Cm.) long and from $\frac{1}{25}$ to $\frac{1}{16}$ inch (1–1.5 Mm.) thick; outer surface ash-gray, marked with somewhat transversely scattered, elongated warts of a brownish color, due to abrasion, and marked more or less with blackish dots, with black, irregular lines or thin ridges, arranged chiefly in a longitudinal direction; underneath the easily removed corky layer of a pale-brownish or reddish-brown color; the inner surface dingy white or brownish; fracture tough, the tissue separating in layers; inodorous; taste somewhat astringent and bitter.

Dose.—1–2 drams (4.0–8.0 Gm.) [30 grains (2 Gm.), U. S. P.].

Official Preparation.

Fluidextrăctum Vibūrni Ŏpuli—Fluidextrăcti Vibūrni Ŏpuli—Fluidextract of Cramp Bark.—*Dose,* 1–2 fluidrams (3.7–7.3 Cc.).

The general observations upon *Viburnum prunifolium* are applicable to this drug.

HYDROCYANIC ACID AND CYANIDES.

Ăcidum Hydrocyănicum Dilūtum—Ăcidi Hydrocyănici Dilūti—Diluted Hydrocyanic Acid. *U. S. P.*

Definition.—A liquid composed of not less than 2 per cent. by weight of absolute hydrocyanic acid, HCN, and about 98 per cent. of water.

Description.—A colorless liquid with characteristic odor, extremely poisonous.

Dose.—1½ minims (0.1 Cc.), U. S. P.

Potăssii Cyănidum—Potăssii Cyănidi—Potassium Cyanide. *U. S. P.*

Origin.—Prepared by heating in an iron crucible a mixture of exsiccated potassium ferrocyanide 8 parts and potassium carbonate 3 parts until effervescence ceases.

Description and Properties.—White, opaque, amorphous pieces, or a white, granular powder, odorless when perfectly dry, but in moist air exhaling the odor of hydrocyanic acid. The taste is sharp and somewhat alkaline, but should be tested with great care, as *the salt is very poisonous.* In moist air it deliquesces; soluble in about 2 parts of water and sparingly soluble in alcohol. Potassium cyanide should be kept in well-stoppered bottles.

Dose.—$\frac{1}{16}$–$\frac{1}{8}$ grain (0.004–0.008 Gm.).

Antagonists and Incompatibles.—Atropine is a physiological antagonist; the diffusible stimulants also tend to counteract the effects of the drug. The metallic salts, particularly cobalt nitrate, are chemically incompatible.

Synergists.—The cardiac and motor depressants.

Physiological and Toxicological Action.—On the skin dilute hydrocyanic acid has little action—more concentrated solutions

cause numbness. On mucous membranes it causes a sensation of warmth; in the mouth salivation occurs, due to its acrid burning and penetrating taste and odor. Numbness follows from the anesthetic action of the acid. On the mucous membrane of the stomach its has a similar action.

Circulatory System.—The heart is less affected than the medullary centers. The primary medullary irritation causes vagus stimulation and a slightly slowed heart—the blood-pressure rising at the same time; but on the advent of the medullary paralysis the pressure falls and the heart beats faster; but the oncoming of a true muscle-poisoning prevents it from beating very rapidly. Heart paralysis is secondary to medullary paralysis.

Nervous System.—In small doses it may cause a sense of giddiness, with temporary nausea and faintness. In toxic doses, however, it has a very pronounced action. The medullary centers are primarily involved, followed by other nervous centers. The respiratory center is primarily stimulated, rendering the respiratory movements fuller and more rapid. Convulsive respiratory movements and dyspnea supervene on larger doses—the rhythm being also influenced by the onset of generalized convulsive seizures which are characteristic of poisoning. Paralysis of respiration follows.

Consciousness is in the early stages clouded, headache and mental confusion are present, and complete unconsciousness soon develops if the dosage is large. Vasomotor and muscle paresis is later evident from the loss of blood-pressure and involuntary fecal and urinary evacuations.

Metabolism.—Hydrocyanic acid has a marked activity in intracellular metabolism. It seems to lock up, as it were, the vital processes—retarding them or completely destroying them, according to the grade of poisoning. It seems to prevent oxygen-absorption particularly. The venous blood retains its bright-red color because of the lack of reduction of the oxyhemoglobin.

Cyanide of potassium differs from hydrocyanic acid in no essential particulars.

BROMIDES.

Potăssii Brōmidum—Potăssii Brōmidi—Potassium Bromide (U. S. P.).—*Origin.*—Prepared by adding bromine to a solution of potassa, evaporating to dryness, mixing with charcoal, heating to redness, dissolving in water, and crystallizing. It should contain not less than 97 per cent. of pure potassium bromide.

Description and Properties.—Colorless or white cubical crystals or granules, odorless, with a pungent, saline taste; permanent in air; soluble in about 1.5 parts of water and in 180 parts of alcohol at 25° C.

Dose.—5–60 grains (0.3–4.0 Gm.) [15 grains (1 Gm.), U. S. P.].

Sōdii Brōmidum—Sōdii Brōmidi—Sodium Bromide (U. S. P.).—*Origin.*—Obtained from a solution of soda in the same manner as potassium bromide. It should contain when dried not less than 97 per cent. of pure sodium bromide.

Description and Properties.—Colorless or white cubical crystals, or a white granular powder, odorless, and with a saline, slightly bitter taste. From air the salt abstracts moisture without deliquescing. Soluble in 1.7 parts of water and in 12.5 parts of alcohol at 25° C. It should be kept in well-stoppered bottles.

Dose.—10–60 grains (0.6–4.0 Gm.) [15 grains (1 Gm.), U. S. P.].

Ammōnii Brōmidum—Ammōnii Brōmidi—Ammonium Bromide (U. S. P.). —*Origin.*—Obtained by neutralizing hydrobromic acid with ammonia or ammonium

carbonate, evaporating, and crystallizing. It should contain not less than 97 per cent. of pure ammonium bromide.

Description and Properties.—Colorless, transparent, prismatic crystals, or a white crystalline powder, odorless, and of a pungent, saline taste; permanent in the air. Soluble in 1.2 parts of water and in 12.5 parts of alcohol at 25° C.

Dose.—5–30 grains (0.3–2.0 Gm.) [15 grains (1 Gm.), U. S. P.].

Līthii Brōmidum—Līthii Brōmidi—Lithium Bromide (U. S. P.).—*Origin.*—Prepared by a solution of ferrous bromide and lithium carbonate, the cool liquid being evaporated and crystallized. It should contain when well dried not less than 97 per cent. of pure lithium bromide.

Description and Properties.—A white granular salt, odorless, and having a sharp, slightly bitter taste; very deliquescent. Soluble in 0.6 part of water and very soluble in alcohol. It should be kept in well-stoppered bottles.

Dose.—5–20 grains (0.3–1.2 Gm.) [15 grains (1 Gm.), U. S. P.].

Călcii Brōmidum—Călcii Brōmidi—Calcium Bromide (U. S. P.).—*Origin.*—Prepared by dissolving pure calcium carbonate in hydrobromic acid and evaporating. It should contain not less than 97 per cent. of pure calcium bromide.

Description and Properties.—A white granular salt, odorless, of a sharp, saline taste, and very deliquescent. Soluble in 0.5 part of water and in 1 part of alcohol at 25° C. It should be kept in well-stoppered bottles.

Dose.—10–30 grains (0.6–2.0 Gm.) [15 grains (1 Gm.), U. S. P.].

Zīnci Brōmidum—Zīnci Brōmidi—Zinc Bromide (U. S. P.).—*Origin.*—Prepared by digesting granulated zinc in hydrobromic acid, concentrating the solution, acidulating with hydrobromic acid, and drying upon a water-bath. It should contain when anhydrous not less than 97 per cent. of pure zinc bromide.

Description and Properties.—A white granular powder, odorless, and having a sharp, saline, and metallic taste. Very deliquescent. Readily souble in water and alcohol.

Dose.—1–5 grains (0.06–0.3 Gm.) [2 grains (0.025 Gm.), U. S. P.].

Strŏntii Brōmidum—Strŏntii Brōmidi—Strontium Bromide (U. S. P.).—*Origin.*—Obtained by neutralizing hydrobromic acid with strontium carbonate, filtration, and evaporation. It should contain not less that 97 per cent. of pure strontium bromide.

Description and Properties.—Colorless, transparent, hexagonal crystals, odorless, and having a bitter, saline taste. Very deliquescent. Soluble in 1 part of water and readily soluble in alcohol.

Dose.—5–30 grains (0.3–2.0 Gm.) [15 grains (1 Gm.), U. S. P.].

Ăcidum Hydrobrōmicum Dilūtum—Ăcidi Hydrobrōmici Dilūti—Diluted Hydrobromic Acid (U. S. P.).—*Definition.*—A liquid composed of not less than 10 per cent. by weight of absolute hydrobromic acid and 90 per cent. of water.

Description and Properties.—A clear, colorless liquid, odorless, and having a strongly acid taste. Miscible in all proportions with water and alcohol. It should be kept in glass-stoppered bottles, protected from light.

Dose.—20 minims to 2 fluidrachms (1.23–7.39 Cc.) [1 drachm (4 Cc.), U. S. P.].

Bromofŏrmum—Bromofŏrmi—Bromoform (U. S. P.).—*Definition.*—A liquid consisting of 99 per cent. by weight of absolute bromoform ($CHBr_3$), and 1 per cent. of absolute alcohol.

Obtained by the action of bromine upon equal parts of methylic alcohol and caustic potash.

Description and Properties.—A heavy, transparent, colorless, mobile liquid having an ethereal odor and a penetrating, sweetish taste resembling chloroform. It is only slightly soluble in water, but readily in alcohol and ether. Specific gravity at 25° C., 2.808. It is only slightly volatile at ordinary temperature, boils at 148° C., and solidifies at 6° C.

Absolute bromoform is decomposed in presence of light and air more rapidly than chloroform. The addition of 4 per cent. of alcohol, as in the case of chloroform, will preserve bromoform for months. When decomposed, bromine is set free, which colors the liquid yellowish red.

Dose.—1–5 minims (0.06–0.3 Cc.).

Antagonists and Incompatibles.—The bromides are antagonized by the motor excitants and muscle stimulants. The incompatibles are acids, acidulous and metallic salts. Spirit of nitrous ether is incompatible with the ammonium bromide.

Synergists.—Their action upon the brain is enhanced by opium and the hypnotics, while the cardiac depressants increase the effect of potassium bromide upon the circulatory system.

Physiological Action.—The action of the bromides depends upon both ions found in the salt, since practically all are dissociable. Thus each bromide salt shows a certain amount of variation in its reaction. The action of the bromine ion is distinctive, however. The actions of the Na, K, NH_4, Li, Zn, and Sr ions are also distinctive and obey the general laws of the inorganic salts. Potassium bromide being the most widely employed, its action will be considered in detail first.

Externally and Locally.—Potassium bromide is slightly sedative to mucous membranes when applied locally, lessening the reflex irritability, particularly of the pharynx.

Internally.—Digestive System.—Locally on the mouth and stomach it produces increased salivation and irritation, as a result of its salty taste. Excessive doses have occasioned a sense of coldness in the epigastrium, with nausea and looseness of the bowels.

Circulatory System.—Potassium bromide depresses the circulation, causing the pulse to become slower, softer, and weaker, and shortening the systole while prolonging the diastole of the heart. The caliber of the vessels is diminished, although arterial pressure is lowered. The potassium ion is responsible for the cardiac depression. It is not present in the other bromide salts.

Nervous System.—Potassium bromide acts as a depressant to the cerebrum. It causes a retardation of the flow of ideas and somnolence. The functions of the motor areas are also depressed. This action on the cerebrum is believed to be due to the bromine ion. The sleep caused is of a dull and heavy character, not refreshing, and is not induced in the presence of pain, or great mental anxiety, or grief. On the medulla there is no marked action.

Spinal Cord.—Potassium bromide diminishes the reflex excitability of the spinal cord. This with its action on the motor centers causes marked depression in muscular activity. There is also a marked diminution, under large and continued dosage, in the activity of the sexual function, and the muscular power of the bladder is somewhat impaired. Anesthesia of the bladder, joints, skin, and mucous surfaces is a constant symptom of prolonged administration.

Respiratory System.—Under full doses the respirations are slower and shallower, owing to slight depression of the respiratory center, paralysis of which may cause death, although fatal paralysis may affect the heart because of the poisonous influence of the potassium ion upon the cardiac muscle.

Absorption and Elimination.—The bromides are very rapidly absorbed, and begin to be eliminated quickly, chiefly by the kidneys (increasing the flow of urine), and also by the skin, saliva, intestinal and mammary glands, and the bronchial mucous membrane. The sulphur nitrogen and chlorides in the urine are increased and the amount of phosphates decreased.

Notwithstanding the rapid elimination of the bromides, under prolonged administration they tend to accumulate in the system, being found abundantly in all parts of the body, particularly in the blood. Nerve-structures contain small amounts. The drug is often found in the urine several weeks after stopping its administration. It has been thought that the bromides were able to replace the chlorides in the tissues to a certain extent. This deduction has been made the basis of an important hypothesis for the treatment of epilepsy—to be considered later.

Temperature.—Immoderate doses cause a reduction of temperature, due to depression of the circulation and lessening of tissue-change.

Eye.—There may occur dilatation of the pupil, conjunctival catarrh, diplopia, amblyopia, dimness of vision, and dilatation of the retinal blood-vessels.

Uterus.—A diminution of the catamenia may sometimes be present.

Untoward Action.—The susceptibility of individuals to the untoward action of the bromides is extremely variable. The symptoms observed are—gastric uneasiness with eructation, nausea and vomiting, analgesia of the epiglottis and pharynx, bronchial catarrh, hoarseness and cough, acute coryza and conjunctivitis, offensive breath, dysuria, diminished sensibility of the genito-urinary mucous membrane, and a variety of cutaneous eruptions.

Poisoning.—*Bromism,* as the symptoms of poisoning are termed, may be divided into an acute and a chronic form.

Acute Bromism, resulting from a single toxic dose, is manifested by violent frontal headache, great muscular weakness, incoördination of movements, abolition of reflexes, somnolence, slow and shallow breathing, subnormal temperature, lusterless eyes, and very slow and weak pulse, death usually extremely rare, resulting from either respiratory or cardiac failure. Death has resulted from 2½ ounces (75 Gm.) taken in a period of forty-eight hours. Treatment of acute bromism is best effected by salt solution by hypodermoclysis, enteroclysis, or infusion.

Chronic Bromism, caused by prolonged use of the bromides, is characterized by mental apathy, constant drowsiness, hallucinations, depression, considerable cutaneous anesthesia, muscular weakness, poor circulation, cold extremities, marked anemia, impairment of the sexual function, deranged digestion, and cutaneous eruptions of various forms collectively designated as "bromine acne."

Its continued use over years may result in permanent mental impairment.

Treatment of Poisoning.—The drug should be immediately withdrawn and methods adopted to hasten elimination, such as the administration of diuretics, cathartics, etc. Tonics, such as strychnine, iron, and the cardiac stimulants, should be given, while exercise and change of scene may counteract the psychical symptoms.

It is claimed that the daily administration of Fowler's solution causes a rapid disappearance of bromine eruption.

Comparative Action of the Bromides.—POTASSIUM BROMIDE

contains 66 per cent. of bromine. It is the most toxic to the heart and muscular system.

SODIUM BROMIDE, 78 per cent. of bromine, is less hypnotic, as the sodium ion is known to increase cerebral activity, but the Na ion being indifferent to heart and muscle, it is less toxic.

AMMONIUM BROMIDE, containing the NH_3 ion, shows slight cardiac stimulation, but is otherwise identical with the potassium salt.

LITHIUM BROMIDE is the richest in bromine, containing 92 per cent., and is probably the most hypnotic of all. Its action more nearly resembles that of the sodium salt.

CALCIUM BROMIDE, while resembling them in its action, is less energetic than the other bromides.

ZINC BROMIDE is the most irritant, and is supposed to possess both tonic and sedative properties.

STRONTIUM BROMIDE is the mildest of all, being less prone to cause bromism. Its action is slow.

DILUTED HYDROBROMIC ACID in its action resembles the bromides, though much less depressant than the potassium salt, and less likely to occasion symptoms of chronic poisoning. As an acid it is a gastric irritant.

Therapeutics.—*Externally and Locally.*—*Pharyngitis* is relieved by a gargle containing potassium bromide and potassium chlorate. A solution of potassium bromide diminishes the sensibility of the throat, so that examinations are more easily made. A solution of 4 parts of potassium bromide in 20 parts of glycerin affords a soothing lotion in painful *hemorrhoids*.

Internally.—The BROMIDES are especially useful in allaying excessive brain activity, the *insomnia* (particularly the sleeplessness dependent upon nervous excitement, exhaustion, and irritability) and *headache of cerebral congestion*, yielding readily to these remedies.

They are considered to be very efficient medicinal agents for the relief of *epilepsy*, being given either alone or in combination with some vegetable bitter. Fêré combines with them an intestinal antiseptic, asserting that the union lessens the tendency of bromism. Recent studies of Nencki on the power of potassium bromides to replace, in part, sodium chloride in the tissues suggested the idea of withdrawal of all salt from the epileptic's dietary and to replace it with small quantities of bromide. This permits of complete bromization with smaller quantities and is a distinctly useful procedure.

Being such marked depressants of the reflex centers, they are of decided benefit in nervous spasmodic disorders, and particularly valuable in *infantile convulsions*.

During dentition children suffer from various disturbances due to irritation of the dental nerve—*convulsions*, *cough*, *indigestion*, *diarrhea*, *strabismus*, etc.—in all of which the bromides, being powerful depressants of the reflex mechanism, prove of great value.

Whenever there is increased reflex excitability the bromides are indicated. They are therefore valuable in the *reflex disturbances of the menopause*, *spasmodic asthma*, *laryngismus stridulus*, *whooping*

cough, and other *coughs* of reflex origin. They have also been used in *tetanus* and *strychnine-poisoning*.

Excessive *nervous irritability* is quickly relieved by these remedies, either singly or in combination with some of the antispasmodics, such as asafetida, valerian, etc.

Because they depress the sexual mechanism they are of decided benefit in *spermatorrhea* of the plethoric or in the condition arising from irritation of the deep urethra. *Menorrhagia* resulting from excessive ovarian excitement is frequently relieved by these agents, while *nymphomania* and *delirium tremens* are often greatly benefited by full doses of the bromides.

The AMMONIUM BROMIDE has been employed with benefit, it is said, in *diabetes* of nervous origin. *Cerebral vomiting* and the *vomiting of pregnancy* are sometimes singularly amenable to the influence of the bromides.

A combination of SODIUM BROMIDE, spirit of nitrous ether, and tincture of aconite, in anise water, as a remedy in *acute febrile attacks* of children with delirium is of distinct value. Small doses are given at frequent intervals until there is a decided improvement in the symptoms.

The sedative action upon the circulatory apparatus exerted by potassium bromides renders it valuable in *cardiac irritability* when not due to anemia. It is particularly useful in quieting the heart's action in *exophthalmic goiter*.

The bromides are distinctly valuable in combination with chloral to relieve *chordee* and to diminish the tendency to sexual excitement which is antecedent to this condition. In irritative cystitis the bromides are also of service.

Bromides are useful in the convulsive respiratory disorders, and are also helpful in *seasickness*.

DILUTED HYDROBROMIC ACID is used for the same purposes as the bromides, some clinicians preferring it to the latter to quiet the *delirium of simple continued fevers*. It is employed extensively to relieve the symptoms of *cinchonism*.

Bromoform is useful as an antispasmodic in *whooping cough*, but it should be carefully administered, as dangerous collapse, as in chloroform poisoning, has been frequently reported.

Contraindications.—The bromides are contraindicated in conditions of great debility, anemia, or fatty or weak heart with low arterial pressure.

Administration.—The bromides should be given in solution, and when long continued, as in the treatment of epilepsy, they should be accompanied by restorative agents. Carbonated waters, milk, and aromatic elixir serve as efficient vehicles to disguise the taste of these salts.

Children acquire a remarkable tolerance for the bromides, so that large doses may be given them with little danger.

Bromoform may be dropped into a spoonful of water and administered in this simple manner, or it may be dissolved in glycerin.

The diluted hydrobromic acid should be given in water or syrup.

MOTOR EXCITANTS.

From a general point of view there are a large number of drugs that might readily be classed as motor excitants. Thus belladonna causes increased motor excitability, and might be here included. This illustrates the futility in the present state of pharmacological knowledge of employing such widely descriptive terms. The drugs belonging to this group excite the functional activity of the spinal cord and the sympathetic nervous system. They serve to stimulate muscular contraction and the functional operations of the heart, lungs, and secretory apparatus.

It is difficult to separate by sharply defined limits the remedies having these actions and group them according to their analogous therapeutic uses. In the present group, for instance, are placed ergot and gossypium, chiefly used for their action upon the uterus, while those drugs which, although excitomotors, are employed principally for their action upon the circulatory system are placed in the group of *cardiac stimulants.*

The strychnine group of motor excitants contains a number of drugs that act largely on the spinal cord, increasing the activity of its reflex functions. The more important of these are *nux vomica,* containing strychnine and brucine; *thebaine* in opium; *gelsemium,* the gelsemine of which acts as strychnine; the gelseminine, as has already been seen, behaving like coniine; *spigelia* also contains a tetanizing alkaloid; *physostigma* contains calabarine of similar action.

Bacillus tetani contributes a tetano-toxin, with a typical strychnine-like action.

Nux vomica itself has been widely used in medicine. Our modern knowledge dates back to 1540, when it was exported from the East Indies. Many of the natives of Java and of South America have used various species of *strychnos* in the preparation of arrow poisons.

The most typical member of the group is nux vomica.

Nŭx Vŏmica—Nūcis Vŏmicæ—Nux Vomica.
U. S. P.

Origin.—The dried, ripe seed of *Strychnos Nux-vomica* L. Yielding when assayed not less than 1.25 per cent. of strychnine.

Nux vomica is a small tree common in many parts of Hindustan, Farther India, some of the East Indies, and in some parts of Australia.

Description and Properties.—Nux vomica is about 1 inch (25 Mm.) in diameter, orbicular, grayish or greenish-gray; soft-hairy, of a silky luster, with a slight ridge extending from the center of one side to the edge; internally horny, somewhat translucent, very tough, with a large circular cavity, into which the heart-shaped, nerved cotyledons project. It is inodorous and persistently bitter.

Nux vomica contains two important alkaloids—*strychnine* and *brucine*, the former being in excess. The seeds also contain igasuric acid, with which these alkaloids are combined. Of total alkaloids the drug should contain from 2.5 to 5 per cent. Strychnine is a quinoline derivative, brucine being closely related. The former is found in from ½ to 2 per cent. in the seed, the latter in smaller proportions, but in *Strychnos ignatia* brucine is found in comparatively large quantities. Strychnine was isolated by Pelletier in 1818, brucine in the following year, and notwithstanding constant research their exact composition is not definitely known. Suffice it for the present to class them with the chinolin alkaloids.

Dose.—1–5 grains (0.06–0.3 Gm.) [1 grain (0.065 Gm.), U. S. P.].

Official Preparations.

Extrăctum Nŭcis Vŏmicæ—Extrăcti Nŭcis Vŏmicæ—Extract of Nux Vomica.—*Dose*, $\frac{1}{8}$–$\frac{1}{2}$ grain (0.008–0.003 Gm.) [$\frac{1}{4}$ grain (0.015 Gm.), U. S. P.].

Flŭidextrăctum Nŭcis Vŏmicæ—Flŭidextrăcti Nŭcis Vŏmicæ—Fluidextract of Nux Vomica.—*Dose*, 1–5 minims (0.06–0.3 Cc.) [1 minim (0.05 Gm.), U. S. P.].

Tinctŭra Nŭcis Vŏmicæ—Tinctŭræ Nŭcis Vŏmicæ—Tincture of Nux Vomica (0.1 Gm. strychnine in 100 Cc.).—*Dose*, 5–20 minims (0.3–1.2 Cc.) [10 minims (0.6 Cc.), U. S. P.].

Strychnīna—Strychnīnæ—Strychnine. *U. S. P.*

Origin.—An alkaloid obtained from nux vomica, and also derived from other plants of the *Loganiaceæ.*

Description and Properties.—Colorless, transparent, octahedral or prismatic crystals, or a white, crystalline powder, odorless, and having an intensely bitter taste, perceptible even in highly dilute (1 : 700,000) solution. Permanent in the air. Soluble at 15° C. (59° F.) in 6400 parts of water, in 110 parts of alcohol, in 2500 parts of boiling water, and in 12 parts of boiling alcohol; also soluble in 7 parts of chloroform, but almost insoluble in ether.

Dose.—$\frac{1}{64}$–$\frac{1}{16}$ grain (0.001–0.004 Gm.) [$\frac{1}{64}$ grain (0.001 Gm.), U. S. P.].

Official Preparations.

Strychnīnæ Nītras—Strychnīnæ Nitrătis—Strychnine Nitrate (U. S. P.).—Colorless, glistening needles, odorless, and having an intensely bitter taste; permanent in the air. Soluble in water (1 : 42), alcohol (1 : 120), and glycerin (1 : 60); much more soluble in warm water or alcohol. The nitrate contains no water of crystallization and is permanent in the air.—*Dose*, "Average dose: $\frac{1}{64}$ grain (0.001 Gm. = 1 milligramme)," U. S. P.

Strychnīnæ Sŭlphas—Strychnīnæ Sulphătis—Strychnine Sulphate (U. S. P.).—*Description and Properties.*—Colorless or white, prismatic crystals, odorless, and having an intensely bitter taste, perceptible even in highly dilute (1 : 700,000) solution. Efflorescent in dry air. Soluble at 25° C. in 31 parts of water and in 65 parts of alcohol; also soluble in 2 parts of boiling water and 8.5 parts of boiling alcohol. Almost insoluble in ether.—*Dose*, $\frac{1}{64}$–$\frac{1}{16}$ grain (0.001–0.004 Gm.) [$\frac{1}{64}$ grain (0.001 Gm.), U. S. P.].

Strychnine or its salts enter into a number of official preparations.

Antagonists and Incompatibles.—Chloral, chloroform, ether, and other of the methane derivatives antagonize the toxic action of strychnine.

The incompatibles are tannic acid, bromides, iodides, and chlorides.

Synergists.—The motor excitants, ergot, ustilago, electricity, and cold.

Physiological Action.—Since strychnine fully represents the physiological action of nux vomica, that of the former is here given.

Externally and Locally.—In large doses strychnine acts as an antiseptic, but on account of its poisonous nature it is too dangerous to be serviceable. When applied locally to unicellular organisms, in very dilute solutions, the drug acts as a stimulant, increasing their movements. In slightly more concentrated solutions strychnine arrests these movements and destroys life.

Internally.—Digestive System.—Strychnine is an excellent stomachic tonic, improving the appetite greatly and aiding digestion. By its action as a bitter it reflexly stimulates the saliva and increases the secretion of gastric juice, and by imparting tone to the muscular walls of the intestines it increases peristalsis and allays constipation

when due to lack of muscular tone. Strychnine is fully absorbed and exerts its chief activities in the spinal axis.

Circulatory System.—Strychnine stimulates the heart by its action on the cardiac muscle. Pharmacologically the pulse should be decreased, owing to the stimulating action of the vagus center in the medulla. But this depressing influence seems to be overcome by the direct stimulating action upon the heart-muscle. In therapeutic doses it is generally held that the pulse is slightly increased. In poisonous doses the pulse is slowed and weakened, owing to overstimulation of both the heart-muscle and the motor mechanism. There is marked increase in the blood-pressure, with constriction of the vessels, particularly those of the viscera.

Nervous System.—Strychnine increases markedly the excitability of the central nervous axis. On the cerebrum it acts as an excitant, particularly keying up the patient. The motor cortex is somewhat stimulated. The acuity of the special senses is heightened. It stimulates attention. Even its cerebral action may be interpreted, however, as due to an increase in the reflex excitability. Physiologically it may be said that the motor and sensory neurons are more closely bound together, either being more permeable to nervous influences or their insulation becomes reduced. There is no direct impairment of consciousness as the result of large doses.

Spinal Cord and Peripheral Nerves.—The first symptom of the drug is an increase in the spinal reflexes. This Holton and Muirhead think is due to a diminished resistance between the cells in the anterior and posterior horns of the cord. Normally, stimulation of a certain part—as, for instance, of a frog's toe—simply occasions a movement of the part stimulated, no other point being affected. But under the influence of strychnine the slightest stimulation is often sufficient to throw the whole body into tetanic contraction, showing that not only is the resistance in the normal path followed by lessened reflexes, but that resistance in all directions is diminished to such an extent that the impulse affects the entire muscular system. This action on the reflexes is principally on the cord. In fact, the action of strychnine upon the cord seems to be more powerful than upon any other portion of the central nervous axis. Very large doses of strychnine cause paralysis of the motor apparatus, with loss of voluntary movement, due to overstimulation of the reflex centers in the cord, producing exhaustion.

It must be remembered that strychnine does not increase the automatic powers, but simply augments their susceptibility to external stimulation; the slightest external stimulus leading to a greatly exaggerated reflex; he exact mechanism in man is not yet known. Analogies drawn from the reflexes in frogs are not reliable. The reflexes in the human spinal cord are so complex that a study of the action of strychnine on monkeys alone will probably unravel the actual feature in its activity.

Respiratory System.—By the stimulating effect of strychnine upon the respiratory center in the medulla the breathing is rendered

quicker and deeper. Owing to the tetanic contractions of the respiratory muscles, under poisonous doses the breathing is greatly interrupted, and the patient may become asphyxiated. At length, the respiratory muscles becoming completely exhausted, death ensues either from excessive tetanic contraction and asphyxiation or from central respiratory paralysis. It is to be noted that the heart continues to beat for some time after respiration has ceased.

Absorption and Elimination.—Strychnine is rapidly absorbed and slowly excreted. It is eliminated mainly by the kidneys, appearing in the urine as strychnine, and is also slightly excreted by the skin and the salivary glands. It has been detected in the urine as late as eight days after ingestion.

Metabolism.—From its marked action in increasing muscular activity metabolism is greatly hastened. Carbon dioxide is increased and there is heightened oxidation.

Temperature.—Under therapeutic doses the temperature is slightly raised, owing to increased oxidation, as shown by the increase of urea and carbon dioxide eliminated, and of oxygen taken in. During the tetanic convulsions the body temperature is markedly raised, though it is generally greatly reduced during the stage of exhaustion immediately preceding death.

Eye.—The general nervous stimulation produced by strychnine affects the mechanism of the eye; vision, as has been remarked, being rendered more acute.

Untoward Action.—Certain peculiar manifestations, having but slight resemblance, or none whatever, to the characteristic symptoms of poisoning, have followed the ingestion of small doses of strychnine, such as scarlatiniform eruption; cramps followed by perspiration, resembling in some respects the tertian type of intermittent fever; redness of the eyes; formication; a peculiar heaviness and stiffness of the limbs; persistent and painful priapism; and gastric uneasiness.

Poisoning.—As is the case with other active poisons, strychnine in lethal doses produces varying effects, dependent upon temperament, idiosyncrasy, and physiological conditions. Generally speaking, the absorption of large doses is followed by rigidity of the lower maxillary, dilatation of the pupils, increased action of the reflexes, and spasmodic and distressing muscular contraction, affecting the extensors particularly. Finally, the respiratory muscles are affected with tetanic rigidity, death resulting from asphyxia. In many cases the earliest symptoms of poisoning are restlessness and anxiety, twitching of the muscles, and stiffness of the neck. Spinal convulsions are manifested, the patient assuming the position of opisthotonos, so that he rests upon his head and his heels.

The slightest external irritation at this stage, even a movement of the bedclothes, is sufficient to cause a recurrence of convulsions. Notwithstanding these grave symptoms, the mind remains unaffected until carbonic-acid poisoning sets in, and the stomach is usually retentive. Accompanying the usual symptoms in cases of acute poisoning is the distortion of the features, which assume

a ghastly grin (*risus sardonicus*). The action upon the genito-urinary tract is quite marked, involuntary ejaculations of semen frequently taking place, together with incontinence of urine.

The earlier paroxysms attendant upon the effects of the drug are seldom fatal, but in the intervals of repose the patient's mind is oppressed with a sense of impending dissolution, intensified by each renewed access of spasm and increasing severity of pain.

Symptoms from $\frac{1}{3}$ grain usually begin $\frac{1}{2}$ hour after taking. Patients have been known to die from fatal dose in 15 minutes. Two hours is more often—6 to 8 hours also. Minimum lethal dose lies between $\frac{1}{2}$ to $\frac{1}{6}$ grain (.030–.010 Gm.). Birds are usually immune to strychnine.

Treatment of Poisoning.—Emetics and cleansing of the stomach are naturally of the first importance. Animal charcoal and tannic acid should be freely administered, while copious anal injections containing potassium bromide and chloral are often efficacious in relieving the spasms. Chloroform may be needed. Artificial respiration is imperative, but must be continued for a long time, as the drug is so slowly eliminated.

Therapeutics.—The chief local action of strychnine is that of a bitter. There is no more efficient remedy in *atonic dyspepsia* than nux vomica or strychnine. Both possess all the properties of the simple bitters, besides stimulating the nerve-centers, rendering the coördination of the digestive process more perfect and enabling the stomach to respond more readily when the stimulus of food is applied to it. Small doses, 5 to 10 minims of the tincture, frequently repeated—intermitting.

The *gastric catarrh* of inebriates is especially benefited by this drug, which also serves a useful purpose in the *vomiting of pregnancy* and *of phthisis.*

Its tonic action upon the intestinal muscles renders it an invaluable remedy in *habitual constipation*, *atonic diarrhea*, and *prolapsus of the rectum.*

Strychnine is a most valuable cardiac tonic, having a marked action on the cardiac nervous system and also upon the heart-muscle. In *pneumonia*, *typhoid fever*, and other diseases accompanied by dyspnea and feeble heart-action, it is very beneficial. It is particularly valuable in failing blood-pressure. The hypodermic injection of full doses of strychnine ordinarily renders the pulse full and strong, even when it is scarcely perceptible, and death appears imminent. Many clinicians believe that they have tided pneumonic patients over the critical period by the heroic use of strychnine. The *functional irregularity of the heart's action* accompanying *hysteria*, *hypochondriasis*, and *pregnancy* is greatly relieved by moderate doses of tincture of nux vomica.

As a tonic in *chlorosis* and *anemia* strychnine is an esteemed remedy, particularly in combination with iron and arsenic.

In *bronchial* and *neurotic asthma*, as well as in many forms of *neuralgia*, particularly the visceral variety, the drug is an efficient

remedy. In *bronchitis* also, and to relieve the *coughs*, of neurotic origin, it is of great value.

Strychnine is particularly valuable in all of the affections of the spinal-peripheral motor neuron. Anterior poliomyelitis, and the various neuritides. Lead, alcohol, tobacco, diphtheria, typhoid, grippe, pressure *neuritides* are much benefited by large doses.

Strychnine is exceedingly efficacious in *amaurosis* due to excessive use of alcohol or tobacco, being also valuable in *paresis of the ocular muscles*. *Night-blindness* is also greatly benefited by this drug.

The weak and semiparalytic condition sometimes induced by bromides is improved by strychnine.

Hammond has obtained excellent functional results in *tabes* from massive doses of strychnine.

It is of undoubted merit in *delirium tremens*, as well as in preventing the usual effects of alcoholic intoxication; in fact, the drug is one of the best remedies in the treatment of *alcoholism*, the strychnine nitrate being usually employed—hypodermically. According to the best authorities on dipsomania, strychnine seems to be a true antagonist to the untoward action of alcohol, and it is probably the important constituent of the numerous "cures" for the alcohol habit.

No less valuable is strychnine in the treatment of acute *poisoning* by *chloral*, *morphine*, and *physostigmine*.

As an aphrodisiac it is of unquestioned value in *functional spermatorrhea*, and it is thought to produce contractions of the gravid uterus and cause *abortion* or *premature delivery*. When a predisposition to *post-partum hemorrhage* exists, the administration of strychnine may prove of great service.

Finally, strychnine has been highly recommended in the *night-sweats of phthisis* and in *diabetes mellitus*.

Contraindications.—Strychnine is contraindicated in acute inflammatory conditions of the spinal cord and excessive reflex irritability.

Administration.—The extract of nux vomica, the tincture, the fluidextract, or the alkaloid strychnine may be given and gradually increased. Better results are usually obtained if the drug is withheld for a time after its gradual use. The salts of strychnine are preferable to other preparations, the crude drug and its preparations varying greatly in strength, 10 minims (0.6 Cc.) of one tincture sometimes containing as large a percentage of strychnine as 20 minims (1.2 Cc.) of another.

The drug should be cautiously administered to children, the initial dose for a child five or six years of age not exceeding $\frac{1}{100}$ grain (0.0006 Gm.).

In using strychnine hypodermically the soluble hypodermic tablets should be freshly dissolved in distilled water.

The solution of strychnine and of the other alkaloids should not be kept in stock, as they become contaminated with microscopic plants.

Hydrăstis—Hydrăstis—Hydrastis. *U. S. P.*

(GOLDEN SEAL.)

Origin.—The dried rhizome and roots of *Hydrastis canadensis* L., yielding, when assayed, not less than 2.5 per cent. of hydrastine. Closely related to strychnine in some particulars, and also having a marked action on unstriped muscle, raising blood-pressure, exerting an influence on the uterine muscle and on the walls of the stomach and bladder in the alkaloid hydrastine of hydrastis. Hydrastis is a perennial native to Canada and the United States east of the Mississippi, growing in rich woodlands and in the Southern States, confined to mountainous districts.

Description and Properties.—The rhizome is from 1 to 2 inches (2–5 Cm.) long and about ¼ inch (6 Mm.) thick, oblique, with short branches, somewhat annulate and longitudinally wrinkled; externally brownish-gray; fracture short, waxy, reddish-yellow, with a thickish bark, about ten narrow wood-wedges, broad medullary rays, and large pith. Roots thin, brittle, with a thick yellow bark and subquadrangular woody center. Odor slight, taste bitter.

The principal constituents are *hydrastine* (colorless and slightly acrid), *berberine* (yellow and intensely bitter), and *xanthopuccin* or *canadine*. Berberine is also found in berberis, colombo, menispermum, coptis, etc. Hydrastinine, an artificial alkaloid prepared from hydrastine, has a very marked action on blood-pressure.

Hydrastine is related chemically to narcotine, of the opium series.

Dose.—30 grains (2 Gm.), U. S. P.

Official Preparations.

Flūidextrăctum Hydrăstis—Flūidextrăcti Hydrăstis—Fluidextract of Hydrastis.—*Dose*, 10–30 minims (0.6–2.0 Cc.) [30 minims (2 Cc.), U. S. P.].

Glycerītum Hydrăstis—Glycerīti Hydrăstis—Glycerite of Hydrastis.—Used externally.—*Dose*, 30 minims (2.0 Cc.), U. S. P.

Tinctūra Hydrăstis—Tinctūræ Hydrăstis—Tincture of Hydrastis (20 per cent.).—*Dose*, 30–60 minims (2.0–4.0 Cc.) [1 dram (4 Cc.), U. S. P.].

Hydrastīna—Hydrastīnæ—Hydrastine.—An alkaloid obtained from hydrastis.

Origin, Description, and Properties.—Colorless, very brilliant, glassy crystals; taste slightly acrid; fully soluble in ether and chloroform, but freely soluble in water.—*Dose*, $\frac{1}{32}$–¼ grain (0.002–0.03 Gm.) [⅙ grain (0.01 Gm.), U. S. P.].

Hydrastīnæ Hydrochlorīdum—Hydrastinīnæ Hydrochlorīdi—Hydrastinine Hydrochloride (U. S. P.).—*Origin.*—The hydrochloride of an artificial alkaloid derived from hydrastine.

Description and Properties.—Light-yellow, amorphous granules, or a pale-yellow crystalline powder, odorless, and having a bitter, saline taste; deliquescent on exposure to damp air. Soluble in 0.3 part of water and in 3 parts of alcohol. The product should be kept in well-stoppered vials.—*Dose*, $\frac{1}{12}$–½ grain (0.005–0.03 Gm.) [½ grain (0.03 Gm.), U. S. P.].

Antagonists and Incompatibles.—The alkalies, mineral acids, and tannic and other vegetable acids are incompatible with preparations of hydrastis. The physiological antagonists are the methane hypnotics.

Synergists.—Quinine and the vegetable bitters aid its action upon the digestive tract, ergot upon the uterus, and strychnine upon the spinal cord.

Physiological Action.—*Externally and Locally.*—Hydrastine possesses astringent and antiseptic properties when applied locally.

Internally.—Digestive System.—Its action is that of a bitter, stimulating the saliva and enteric secretions. In excessive doses it produces gastric disturbance, almost invariably occasioning vomiting.

Circulatory System.—The vagus is stimulated, causing a preliminary slowing of the heart. It may also have a distinct poisonous

action on the heart-muscle. Arterial tension is raised. Large doses weaken the heart and drop pressure. In its effect upon the white blood-corpuscles it resembles quinine.

Nervous System.—The action of hydrastis on the nervous system is similar in many respect to that of strychnine, particularly on the medulla and spinal cord. Cerebral effects are not described with definiteness in man.

Spinal Cord and Peripheral Nerves.—The cord is stimulated. The reflexes are increased with tonic, and at times clonic, convulsions, and tetany of the respiratory musculature may occur.

Respiratory System.—It stimulates the respiratory center.

Absorption and Elimination.—It is slowly absorbed, tending to accumulate in the system. It is eliminated chiefly by the kidneys, increasing slightly the urinary flow.

Temperature.—Medicinal doses have no effect; poisonous doses decrease bodily heat.

Eye.—It has no particular action upon the eye, other than at first to contract and then to dilate the pupil when directly applied.

Uterus.—Hydrastine is a feeble oxytocic, affecting the womb in a manner similar to, though much less powerful than, ergot.

Pembrey and Phillips claim that it has no action on the uterus.

Poisoning.—The symptoms are almost identical with those of strychnine, and the same line of treatment is to be followed. Fatal poisoning is practically unknown.

Therapeutics.—*Externally and Locally.*—The fluidextract of hydrastis, 15 to 20 minims (1.0–1.2 Cc.) to 4 ounces (118 Cc.) of water, makes an efficient injection in *gonorrhea.*

The topical action of hydrastis and its preparations is that of an antiseptic and tonic, strengthening the circulation and nutrition, rendering the drug peculiarly valuable in diseases of mucous surfaces.

The TINCTURE—1 fluidram (3.7 Cc.) to 1 ounce (30.0 Cc.) of water—is a valuable mouth-wash in all *indolent* and *offensive ulcerations of the mouth and throat,* such as *syphilitic and mercurial affections, follicular pharyngitis,* etc.

The FLUIDEXTRACT serves a useful purpose in the local treatment of *anal fissures* and of *rectal ulcer, vaginal* and *uterine ulcerations* and *leukorrhea. Indolent ulcers* are stimulated by the bitter action to a healthier condition by the application of this preparation.

Internally.—As a remedy for diseased conditions of the stomach and bowels it is of much the same value as the vegetable bitters and may be used for the same purpose.

HYDRASTINE, and more particularly hydrastinine or its closely related body *cotarnine,* acts upon the uterus very much like ergot, and has been highly recommended by well-known authorities in *uterine hemorrhages* and other uterine disorders for which ergot is used. By careful observers, of experience with the drug, it is considered superior to ergot in the *hemorrhage of puberty* and the *menopause* as well as *congestive dysmenorrhea.*

Königer has treated *hemoptysis* successfully with the FLUID-

EXTRACT in 20- or 30-minim (1.2–2.0 Cc.) doses, repeated several times a day. The drug has proved equally beneficial in arresting the *night-sweats of phthisis*, and is an efficient substitute for alcoholic stimulants when their use is abandoned.

Administration.—When taken for its action upon the stomach and bowels it should be given before meals; for its effect on the uterus it is best administered in divided doses or the hydrastine hydrochlorate hypodermically.

Cotarnine is a synthetic product from narcotin, and used as a styptic and in uterine hemorrhage in ½-grain doses thrice daily or oftener.

COCA.

Erythroxylon Coca.—Students frequently confuse this drug with the cacao that gives the widely used drink cacao and chocolate, the *Theobroma cacao.* Needless to say they are widely separated products. The active principle of Erythroxylon is COCAINE, also a tropein derivative. It is also supposed to be a methyl piperidine. Its structural formula reveals a close relationship to that of atropine.

Cōca—Cōcæ—Coca. *U. S. P.*

Origin.—The dried leaves of *Erythroxylon Coca* Lam., known commercially as Huanuco Coca or of E. Truxillense, Rusby, known commercially as Truxillo Coca, yielding when assayed not less than 0.5 per cent. of the ether-soluble alkaloids of coca.

Coca is indigenous in the mountains of Peru and Bolivia, and on the eastern slopes of the Andes, is cultivated in damp, warm valleys from 3000 to 6000 feet (914.5–1829 M.) above the sea-level, being also grown in some parts of Colombia, Brazil, the Argentine Republic, and the island of Java. The province of La Paz in Bolivia produces the largest crops, the article being more highly esteemed than the Peruvian variety. *Cocaine* is obtained from leaves of several varieties of *Erythroxylon.*

The active constituent is the alkaloid *cocaine*, 0.36 to 1.67 per cent. The plant also contains a number of allied alkaloids, *cinnamyl cocaine*, *cocamine*, *isococamine*, *tropacocaine*, *hygrine*, etc. These are all found in minute quantities.

Dose.—½–4 drachms (2.0–16.0 Gm.) [30 grains (2 Gm.), U. S. P.].

Official Preparations.

Flūidextrāctum Cōcæ—Flūidextrācti Cōcæ—Fluidextract of Coca.—*Dose*, 20 minims–1 fluidrachm (1.2–4.0 Cc.) [30 minims (2 Cc.), U. S. P.].

Vīnum Cōcæ—Vīni Cōcæ—Wine of Coca (U. S. P.).—An official wine prepared from the fluidextract of coca.

Dose.—Average dose: 4 fluidrachms (16 Cc.). U. S. P.

Cocaīna—Cocaīnæ—Cocaine.

Definition.—An alkaloid [$C_8H_{13}(C_6H_5CO)NO.COOCH_3$] obtained from several varieties of coca.

Description and Properties.—Slightly soluble in water (1 : 600), much more so in alcohol (1 : 5), more readily in both when warm; insoluble in glycerin.

Cocaine is a methyl compound of benzoylecgonine. When it is boiled with water methyl alcohol is first split off, then benzoic acid; these changes occur more rapidly with dilute acids or barium hydroxide. Conversely cocaine may be built up by introducing the methyl and benzoyl groups into ecgonine (a compound having the empirical formula, $C_9H_{15}NO_3$).

Dose.—"Average dose: 0.030 Gm. = 30 milligrammes (½ grain)." U. S. P.

Official Preparation.

Oleātum Cocaīnæ—Oleāti Cocaīnæ—Oleate of Cocaine.—Containing 5 per cent. of cocaine.

Cocaīnæ Hydrochlōridum—Cocaīnæ Hydrochlōridi —Cocaine Hydrochloride. *U. S. P.*

Definition.—The neutral hydrochloride of the alkaloid cocaine.

Description and Properties.—Colorless, transparent crystals or a white, crystalline powder, odorless, of a saline, slightly bitter taste, and producing upon the tongue a tingling sensation followed by numbness of some minutes' duration. Permanent in air, soluble in 0.4 part of water and 2.6 parts of alcohol at 25° C.; very soluble in boiling water and in boiling alcohol.

Dose.—⅛–2 grains (0.008–0.12 Gm.) [½ grain (0.03 Gm.), U. S. P.].

Antagonists and Incompatibles.—Morphine, chloral, amyl-nitrite, alcohol, chloroform, and ether are physiological antagonists. The most direct opponents are chloral and morphine.

Cocaine is incompatible with caustic alkalies and the alkaline carbonates and bicarbonates, as well as with bichloride of mercury, iodine and the iodides, ammonia, zinc chloride, and borax.

Synergists.—Medicinally, its cerebral effects may be enhanced by the cerebral stimulants, such as alcohol, cannabis Indica, and belladonna, while its analgesic and anesthetic action may be aided by carbolic acid, atropine, opium, and conium. When used as a mydriatic, atropine serves as a valuable synergist.

Physiological Action.—For our first knowledge of the physiological properties of coca we are indebted to its empirical use among the natives of Peru. The history of the drug is replete with interest and romance. It was regarded as the living representation of the Deity, the ground whereon it grew being held sacred. During the reign of the Incas its use was a royal privilege, the people being compelled to obtain permission from the governor to avail themselves of its benefits. Later it was adopted indiscriminately.

The native *coqueros* (coca-chewers) have learned from experience that they can climb the Andes, work laboriously in the mines, and endure fatigue and hunger more hardily when chewing the leaves of the plant, and from time immemorial the drug has been recognized by observers as possessing powerful nutritive, stimulant, and restorative properties.

In describing the action of the crude drug the author can add little to the words of Linnæus, who long ago wrote that coca possessed "the penetrating aroma of vegetable stimulants, the astricting and fortifying virtues of an astringent, the antispasmodic qualities of bitters, and the mucilaginous nutritive properties of analeptics or of alimentary plants." "This leaf," he adds, "exhibits with energy its action on all parts of the animal economy."

Since the isolation of the alkaloid cocaine, to which the drug owes its physiological and medical properties, by Gaedeke in 1855, and the subsequent study of it by eminent pharmacologists and therapeutists, we have learned more of the physiological action of coca. Its effect upon different systems are here described in detail.

Externally and Locally.—Cocaine is anagelsic, anesthetic, and ischemic. Upon the unbroken skin it has no action, but upon

mucous membranes or the subcutaneous tissue it produces complete local analgesia. The surface to which it is applied becomes paler than normal, owing to contraction of the blood-vessels, but afterward reddens and appears turgescent through secondary dilatation of the vessels. The absorption of the drug by mucous membranes varies with the locality to which it is applied—with difficulty from the conjunctiva, yet with great readiness from the Schneiderian membrane, producing its characterisic constitutional effect.

Applied to the conjunctiva, or even taken internally, cocaine causes a transitory contraction of the pupil, soon followed by dilatation. The accommodation is impaired, but not completely destroyed. The ocular tension is lowered. The light reflex is not abolished. There may be a slight exophthalmos.

The analgesic action of cocaine applied locally is due to the depression of the ends of the nerves of pain-sensation. It does not affect the ordinary sensations of touch or temperature to anything like the extent that it affects pain-sensation. It dilates the pupil by stimulating the ends of the sympathetic nerve, which innervates the radiating fibers of the iris.

In addition to its local analgesic action the drug possesses the power of destroying the functions of the nerves of special sense, so taste and smell are abolished. When applied locally or taken internally it primarily checks many of the secretions, though those from the pancreas and liver seem to be uninfluenced by its internal use. The secondary impression of cocaine, however, when the blood-vessels become dilated, is accompanied by increased secretions.

Internally—Digestive System.—Although it has been shown by experiments upon animals that cocaine is incapable of sustaining life, it diminishes in man the sensation of hunger, owing to its local anesthetic action upon the mucous membrane of the stomach, so that the *coqueros* and the modern habitués are able to abstain from food for days, thirst also being allayed. This diminution of hunger does not seem to impair appetite and digestion until habitual cocaine mania destroys the gastric functions almost entirely. This contributes to the great emaciation of these patients.

On account of its stimulant action upon the constrictor fibers of the great sympathetic nerve, under the influence of moderate doses peristalsis is largely increased in the stomach and intestines, very large or poisonous doses, on the contrary, causing great sluggishness of the bowels.

Circulatory System.—Medicinal doses of cocaine increase the force and frequency of the cardiac contractions, and also arterial pressure. Large or poisonous doses render the pulse slow, soft, and weak and lower arterial tension. The exact *modus operandi* is not fully determined, but there is direct stimulation of the heart or its accelerator mechanism. There is a marked rise in blood-pressure due to the cardiac stimulation and to a marked contraction of the blood-vessels from vasoconstrictor stimulation.

Nervous System.—When given internally its first action is upon the cerebrum, moderate doses greatly stimulating the intellectual faculties and producing a feeling of ecstacy and well-being, in many respects akin to the sensations experienced under the action of cannabis Indica. In the course of a few hours the stage of cerebral excitement is succeeded by mental, moral, and muscular depression. The motor cortex is also stimulated, causing increased muscular excitement or restlessness. Garrulousness is usual.

Large doses result in incoherent speech and wild delirium, accompanied by swaying of the head, followed by epileptiform convulsions and narcosis. The convulsions are partly of cerebral or of basal ganglionic origin. There is a distinct increase in the ability to carry on mental labor.

The medulla is markedly stimulated where a distinct action on the centers of breathing and of circulation is manifested.

The sensory nerves are depressed by small and paralyzed by lethal doses. The motor nerves are also depressed by large doses, this action, however, being subordinate to that exerted upon the sensory nerves. The muscles are stimulated by medicinal doses through impression upon the motor tracts, although large doses greatly depress muscular activity. The chewing of coca, as practised by the natives of Peru and Bolivia, undoubtedly appears to augment muscular strength and powers of endurance.

Mosso claims that small doses of cocaine serve as a powerful muscular stimulant in cases of exhaustion from hunger or fatigue. The analgesia produced is largely responsible for the sense of muscular power. Tire is not felt as its physiological accompaniment.

Respiratory System.—Medicinal doses powerfully stimulate the respiratory center, increasing the rapidity and depth of the respirations. Poisonous doses paralyze the center, the result being dyspnea, slower, feeble breathing, and death from respiratory failure, usually ushered in by convulsions, and often Cheyne-Stokes rhythm.

Absorption and Elimination.—Cocaine is quickly absorbed, being eliminated principally by the kidneys in a form differing from its original nature. Much of it probably undergoes oxidation in the body. The amount of urine is increased, though the nitrogenous elements are diminished. The habitual use of the drug lessens urinary secretion.

Cocaine possesses no cumulative action. Metabolism is slightly increased by the augmented muscular activities, but the exact relations of cocaine to metabolism are not yet available.

Temperature.—Medicinal doses have no influence on bodily heat, but poisonous doses usually raise the temperature, owing, according to Reichert, to an increase of heat-production.

Eye.—Cocaine produces a noticeable dilatation of the pupil, as already explained under "Local Action," the maximum change being reached in about an hour, and the normal state regained in from twelve to twenty-four hours.

Cocaine-poisoning.—Among the most prominent physiological symptoms resulting from the ingestion of excessive doses of cocaine or repeated and continued injections are a tendency to coma or collapse; a feeble, thready pulse, often running extremely high; great emaciation; anorexia and impairment of the digestive powers, and increased frequency, and, again, alarming depression of respiration. There are other systems, scarcely less serious, which, as the majority of observations show, render cocaine one of the most generally deleterious of drugs, opium not excepted. Dropsy, marasmus, numbness, syncope, profound malaise, muscular twitchings with mild convulsions, insomnia, amblyopia, mydriasis, visual hallucinations, headache, vertigo, dangerously elevated temperature, dental decay, and fetid breath—even this admonitory catalogue of ills fails to complete the recorded phenomena attending chronic poisoning from cocaine.

Yet, grave as are the foregoing physical changes incident to an immoderate use of the drug, the mental and, above all, the moral effects of cocaine-poisoning are far more deplorable. It is a melancholy but indubitable fact that to one fully committed to the so-called "cocaine habit" there appears at times no principle of honor or decorum to which the vitiated sensibilities are amenable. The enfeeblement of the intellectual faculties, the loss of memory, inability to coördinate or control ideas, a consciousness occasionally merged in pronounced mania, possibly with homicidal inclination, and an intense selfishness of thought and purpose, in which apathy, neglect of domestic obligations, and complete debasement of nobler qualities are developed—these lamentable accompaniments manifest too clearly the degenerating influences exerted by a constant resort to the use of this ill-fated, if not fatal, drug.

It frequently happens that cocainism arises from a desire to relieve effects produced by the immoderate use of opium. Yet the latter drug, being taken to offset the influence of cocaine, in reality but aggravates the evil, the two agents interacting and still further lessening the chances of recovery. Some of the most deplorable cases of drug-habit are the combined morphine and cocaine habitués.

A number of catarrh remedies are on the market at the present time. These consist of mixtures of cocaine and indifferent substances, and are largely responsible for the spread of this pernicious habit. The negro roustabouts of the South are very prone to the habit, and the catarrh cures are in constant use among the prostitute class.

Treatment of Acute Poisoning.—Several antidotes have been favorably adopted—amyl nitrite, caffeine, atropine, and inhalations of ammonia. Chloroform, ether, subcutaneously injected, and strychnine have also proved more or less efficient remedies.

With regard to the withdrawal of cocaine, equally competent authorities appear to differ, the immediate cessation of the drug being advocated, and, again, this course condemned as liable to produce collapse. The general experience of those treating this

class of patients is that a partial cure of the cocaine habit is comparatively easy under careful sanitarium supervision. General tonic treatment is imperative.

Doses of from 35–15 grains have caused death in from eight to nine hours.

Therapeutics.—*Externally and Locally.*—The indications for the local anesthetic action of COCAINE are very numerous. The general surgeon will find many opportunities to employ the drug advantageously; indeed, in many instances it has replaced all other anesthetics. In many operations on the genito-urinary tract, rectum, nose, throat, ear, and eye it serves a most valuable purpose. The urethra can be rendered perfectly insensible to pain by the application of a 2 to 4 per cent. solution, repeated two or three times at intervals of five or ten minutes. Even the sensibility of the bladder itself can be benumbed to a great extent by the local application of a cocaine solution, so that *sounding for stone* and its removal may be painlessly accomplished.

Urethral caruncles may be removed successfully and without inconvenience to the patient by the injection of a 4 per cent. solution at the lines of attachment. An injection of a small amount of the same solution into the cellular tissue of the prepuce prevents pain in *circumcision* and in the operation for *phimosis*. In the treatment of *fistula in ano*, *hemorrhoids*, both internal and external, and other *diseases of the rectum*, cocaine is of signal value.

Cocaine is an important anesthetic in many minor operations, such as opening of *felons*, *abscesses*, etc; it is also highly serviceable in dentistry and for the removal of *small neoplasms*. Probably its most extensive use in this respect is in operations upon the eye, nose, and throat, its widest field of usefulness being in operative ophthalmic surgery.

Small doses of cocaine in combination with antipyrine and adrenalin are very useful in acute coryza. Great care must be taken lest its use in this regard lead to the habit.

The peculiar qualities of cocaine render it one of the safest, as well as most convenient and serviceable, mydriatics. It quickly dilates the pupil, which regains its normal condition in from ten to twenty hours. The dilatation, too, is easily overcome by the application of eserine, a solution of ½ grain (0.03 Gm.) to 1 ounce (30.0 Cc.) of the latter drug being strong enough to neutralize the effects of a 4 per cent. solution of cocaine.

It should be remembered that local applications to the conjunctivæ, nares, and fauces may produce in susceptible persons systemic effects.

Cocaine combined with atropine forms a mydriatic which for many purposes is superior to either drug separately, the mydriasis being of longer duration than that produced by cocaine, while the paralysis of the accommodative apparatus is briefer than that occasioned by atropine. It should be remembered that iso-tropyl cocaine may cause great cardiac depression.

The PHENATE OF COCAINE is less toxic than the hydrochlorate,

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owing to its power of coagulating albumin, and thereby being less readily absorbed. It is also more agreeable to the taste. While it does not produce anesthesia so readily as the hydrochlorate, its effect is more permanent, and, in addition, it possesses powerful antiseptic properties. By many physicians it is preferred in laryngological work.

Internally.—COCA has been successfully used in *gastralgia* and to *improve the digestion*. COCAINE is frequently an efficient remedy in *sea-sickness* and to allay *excessive vomiting*.

Bartholow has highly recommended the drug in *chorea*, *asthma*, *paralysis agitans*, and *alcoholic*, and *senile tremor*. It has also been suggested as a cure for the *opium*, *alcohol* and *tobacco habits*.

Spinal Analgesia.—Within recent years the use of cocaine, thrown into the spinal cord, has been very widespread. It was first pointed out by Corning, of New York, a number of years ago, that the injection of cocaine into the spinal nerve-roots would induce analgesia of the lower limbs, but little practical use was made of this suggestion. Bier, of Kiel, rehabilitated the procedure, adopting the newer points of technic brought out by Quincke in his observations on lumbar puncture, and performed major operations below the umbilicus during the analgesia conferred by the drug. Tuffier, Murphy, Fowler, Bainbridge, Reclus, and many others have supplemented the early observations, and at the present time there is a large literature concerning the intrarachidian injections of cocaine in surgery. Many operations, heretofore impossible to perform by reason of accompanying cardiac or renal disease, thus making the employment of ether or chloroform unwise, have been done successfully under cocaine analgesia. In many respects an ideal has been reached, but there are a number of drawbacks to its use here. Headache, nausea, vomiting, great prostration, and weakness, accompanied by dizziness, have been noted with varying constancy as following the use of the drug in this manner. Its use, therefore, presents some questions of expediency that subsequent experience must answer.

A logical outcome of the use of cocaine in this manner in surgery is its use in persistent neuralgias—sciatic and others. These have been relieved in many instances, most often to return, yet at times not. The pains of tabes have also been markedly relieved by the same procedure.

Time and experience alone will determine what the subsequent developments may be along these lines.

SIMILAR PRODUCTS.—In coca leaves there are other cocaines, and still others are made synthetically from the ecgonine base, but these have not been used to any great extent. *Cocainine*, *benzoyl-ecgonine*, *tropacocaine* have been used sparingly. The last has been employed in spinal analgesia in the place of cocaine.

EUCAINE.—Alpha and beta-eucaine are newer artificial alkaloids used as substitutes for cocaine. They differ from cocaine in that they may be subjected to boiling and are not thereby decomposed. Moreover, they are less toxic and have about equal

analgesic properties. Beta-eucaine is to be preferred, as it is less irritating. On the eye, they do not dilate the pupils so widely and are capable of extensive employment in ophthalmic practice.

HOLOCAINE is a synthetic derivative from phenacetine, used widely in ophthalmic practice for much the same purposes. It is not so satisfactory in many respects.

ORTHOFORM—$C_6H_3OH(NH_2)(COOCH_3)$—meta-amidopara-oxy-benzoic-acid methyl ester, is another product of radically different chemical composition, being derived from benzoic acid. It possesses many of the analgesic properties of cocaine. It is a white, slightly soluble powder, and is useful as a dusting-powder, proving antiseptic and analgesic at the same time. It is extensively used in the treatment of ulcers—rectal, urethral, laryngeal, gastric, etc.—of tuberculous, syphilitic, or carcinomatous origin, and offers excellent opportunities as a local analgesic, as it remains in contact for a considerable space of time because of its comparative insolubility.

ANÆSTHESIN — $C_6H_4\left\langle\begin{matrix}NH_2\\COOC_2H_5\end{matrix}\right.$ —ethyl para-amido-benzoate, is a similar body of like properties with the same general indications.

STOVAINE is a recent (1903) addition to this group. It is a derivative of tertiary amylic alcohol; it crystallizes in little brilliant flakes, resembling cocaine. Its action in some instances is just as efficient as cocaine; in others nearly so. It is most certainly much less toxic, and therefore can be given in larger doses if required.

The following salts of cocaine have been manufactured and are used for much the same purposes as the hydrochloride and in the same dosage: Cocaine aluminium citrate, sulphate, borate, cantharidate, lactate, nitrate, phenate, saccharate, salicylate, and stearate. *Cocapyrine* is a mixture of cocaine and antipyrine, 1 : 100.

Contraindications.—No special or distinct contraindication to its use exists. In diseases of the kidneys with diminished urinary flow it should be cautiously administered, lest total anuria ensues. With subjects suffering from weak or diseased heart, caution is to be used, as collapse has been frequently noted.

Administration.—For hypodermic use, solutions of from 2 to 5 per cent. are generally employed.

It should be noted that children and females require smaller doses of the drug.

It is altogether possible that many of the coca wines on the market contain varying quantities of cocaine. The reckless and indiscriminate prescription of these preparations, therefore, is liable to induce the cocaine habit. It is questionable, indeed, whether the administration of cocaine with a view to curing the intemperate use of opium, alcohol, or tobacco is wise. It frequently happens that patients thus treated lose their craving for the latter drugs only to acquire an inordinate appetite for cocaine, which, as has been shown, is possibly as dangerous as either of them, in its physical and moral effects.

DRUGS ACTING CHIEFLY ON THE CIRCULATORY ORGANS.

THERE is a large group of drugs which, like many of the foregoing, show marked pharmacodynamic action on several tissue systems of the body, and hence on more than one physiological function. Their chief use, however, is to modify, in some definite manner, the circulatory apparatus. They either bring about a marked regulating action on the rhythm of the heart and act on the vessels, as digitalis; or act almost alone on the blood-vessels, as adrenalin or ergot: still others acting purely as reflex stimulants to the heart action, as many of the xanthines, or act distinctly as cardiac depressants, as aconite.

These will be here taken up as a series of groups of drugs with which one can modify the conditions of the circulation. A large number of other factors enter into their full physiological activities, but these are laid aside for the moment.

In this present instance these remedies will be grouped as follows: (1) The Digitalis group, composed largely of drugs that exert a predominant stimulant action on the vessel walls, on the heart walls, and on the cardio-inhibitory apparatus; (2) Adrenalin group, in which the chief activity is exerted on the tissues of the walls of the blood-vessels; (3) the Xanthine or Caffeine group; (4) the Nitrite group, in which the main action consists of vessel dilatation; and (5) the Aconite group, in which heart-muscle and heart-ganglion depression are prominent and vasodilatation is pronounced.

It is preferred to eliminate the terms cardiac stimulants and cardiac depressants, hoping that the student should have in mind the general agents at his command to regulate the circulation, if such regulation is called for in treatment. As opportunity offers, the circulatory action of a number of the drugs already discussed under other headings will be considered. Thus, while alcohol exerts its main action on the nervous system, it plays an immensely important rôle as a remedy to modify cardiac and circulatory activity.

THE DIGITALIS GROUP.

In this group are classed *Digitalis purpurea*, *Strophanthus Kombé*, and *S. hispidus*, *Convallaria majalis*, *Urginea Scilla*, *Helleborus niger*, *Apocynum cannabinum*, *Adonis vernalis*, *Nerium oleander*, *Erythrophlœum Guinense*, and a few others.

It is noteworthy that the active principles in these drugs are glycosides, and while their chemical composition may vary considerably, their pharmacological actions are very similar.

Digitălis—Digitălis—Digitalis. *U. S. P.*

(FOX-GLOVE.)

Origin.—The dried leaves of *Digitalis purpurea* L., collected from plants of the second year's growth at the commencement of flowering. The plant is a biennial, 2 to 5 feet (0.6–1.5 M.) high, indigenous in Southern and Central Europe, and growing wild as far north as Norway. It is also found in Madeira and the Azores, and is well known everywhere as an ornamental garden plant.

Description and Properties.—From 4 to 12 inches (10–30 Cm.) long, ovate or ovate-oblong, narrowed, with a petiole, crenate, dull green, densely and finely pubescent, wrinkled above, paler and reticulate beneath, midrib broad near the base; odor slight, somewhat tea-like; taste bitter, nauseous. The leaves of mullein, *Inula coryza* and *Inula Helenium*, are sometimes mixed with those of fox-glove.

The study of the active principles is fraught with much difficulty, and at the present time it is by no means certain what all of the active bodies are. The following are among the most important constituents: *Digitalin*, $C_{35}H_{56}O_{14}$, a crystalline glycosidal substance, insoluble in water. Digitalin is found mostly in the seeds. *Digitonin*, $C_{27}H_{46}O_{14}$, is another constituent found in greater abundance in the seed, but also present in the leaves. It is a white, powder-like glycoside resembling saponin. It is soluble in water and insoluble in alcohol. A watery solution is capable of holding the water-insoluble glucosides in solution or in suspension. It is an active diuretic principle; *digitoxin*, $C_{34}H_{54}O_{11}$, is the chief glycoside of the leaves and the most active constituent of the plant. It is insoluble in water, soluble in alcohol, chloroform, and ether; *digitophyllin*, $C_{32}H_{52}O_{10}$, is another glycoside derived from the leaves. It resembles digitoxin. *Digitalein* and *digitin* are also present, but are of less importance.

Dose.—½–2 grains (0.03–0.12 Gm.) [1 grain (0.065 Gm.), U. S. P.].

Official Preparations.

Extrăctum Digitălis—Extrăcti Digitălis—Extract of Digitalis.—*Dose*, ⅙–½ grain (0.01–0.03 Gm.) [⅙ grain (0.01 Gm.), U. S. P.].

Flūidextrăctum Digitălis—Flūidextrăcti Digitălis—Fluidextract of Digitalis.—*Dose*, ½–2 minims (0.03–0.12 Cc.) [1 minim (0.05 Cc.), U. S. P.].

Infūsum Digitălis—Infūsi Digitălis—Infusion of Digitalis (1½ per cent.).—*Dose*, 1–4 fluidrams (3.7–15 Cc.) [2 drams (8 Cc.), U. S. P.].

Tinctūra Digitălis—Tinctūræ Digitălis—Tincture of Digitalis (10 per cent.).—*Dose*, 5–20 minims (0.3–1.2 Cc.) [15 minims (1 Cc.), U. S. P.].

Unofficial Preparations.

Digitalīnum—Digitalīni—Digitalin.—*Description and Properties.*—An amorphous, yellowish-white, crystalline powder or scales, or light, white crystalline tufts of needles, odorless and of an intensely bitter taste. Insoluble in water, soluble in alcohol.—*Dose*, $\frac{1}{100}$–$\frac{1}{30}$ grain (0.0006–0.002 Gm.).

Digitŏxin—Digitŏxin—Digitoxin.—*Description and Properties.*—A white crys-

talline body, of a bitter taste; insoluble in water, soluble in chloroform.—*Dose*, $\frac{1}{200}$–$\frac{1}{100}$ grain (0.0003–0.0006 Gm.).

Antagonists and Incompatibles.—The most complete antagonist is saponine, the active constituent of *Saponaria officinalis*. The cardiac depressants antagonize the action of digitalis upon the heart, morphine and the emetics possessing a similar property, though in less degree.

The incompatibles are the ferric chloride and sulphate, preparations of cinchona, tannic acid, and preparations containing it, and the subacetate and acetate of lead.

Synergists.—The cardiac action of digitalis is aided by other members of this group, and also by belladonna and ergot.

Physiological Action.—*Externally and Locally.*—Digitalis is at first irritant to the skin and mucous membrane. Later it may paralyze the sensory end-organs and thus prove an analgesic. Digitoxin seems to be the most active constituent in causing the irritant action.

Internally.—*Digestive System.*—Small doses ordinarily produce no effect upon the stomach. Large doses act as a gastro-intestinal irritant, exciting nausea, vomiting, and diarrhea. These effects may follow the prolonged administration even of small doses.

Circulatory System.—The principal effects of digitalis are upon the circulatory apparatus, the action of the drug varying according to the size of the dose.

In discussing the action of digitalis on the circulatory apparatus, both the results on the heart and on the blood-vessels need considering. So far as the heart is concerned two important factors should be borne in mind: the heart-muscle itself, and the cardiac regulating apparatus, particularly the vagus inhibitory action. Digitalis, as well as all the members of the series, exerts a markedly irritant action on heart-muscle; it also acts, as has been pointed out, as a distinct primary irritant and stimulant to the medulla, hence on the vagus nucleus. There is a play between these two factors, and the effects of digitalis on the heart are to be interpreted in accordance with the respective influences of these two conditions.

Very small doses of digitalis show practically only the results of mild muscle-stimulation. They cause, particularly in susceptible individuals, a slight increase in the force and rapidity of the heart-action.

Larger doses, and especially when repeated, bring out the so-called "therapeutic action" of digitalis. As the heart-muscle feels the stimulation before the vagus center is affected, there is usually, under medicinal doses, a preliminary increase in the rapidity of the heart's action, as well as a distinct increase in its force. In from three-quarters to one hour after giving a medicinal dose the second factor, inhibition, from vagus stimulation, becomes apparent; in some cases it may take several hours fully to estab-

lish the vagus action; then the heart-rhythm becomes slower, the force is increased, the systole is more complete and effective, and usually a larger amount of blood is being pumped every hour throughout the body, and also into the body of the heart-muscle itself.

This condition of increased tone may be held by judicious use of digitalis for considerable periods of time. Should the limit of safe dosage, however, be overstepped, the poisonous action of digitalis may appear. This poisonous action has been interpreted in a variety of ways, but it would appear that two explanations alone are tenable, perhaps only one. It has been held that one of the first results of poisoning is a partial paralysis of the vagus center, this would let up on the inhibitory rein on the heart and it would commence to beat faster, being still stimulated as to its muscle; further loss of inhibitory control would cause arhythmia, and the end result would be a rapid, irregular heart with loss of tone and final exhaustion.

It has been shown, however, in some instances, and these are yet too few to be positive concerning the matter, that artificial vagus stimulation is effective in slowing the heart even in the last stages of poisoning. Should this be interpreted that the vagus centers are not exhausted by digitalis, in order to explain the symptoms noted, it must be assumed that the muscle stimulation has become so excessive that even the vagus inhibition is ineffectual in controling it, hence the rapid irregular heart-action is a result of intense muscle irritability brought about by the members of this series. According to this view there is, in the final stages of poisoning, a distinct delirium cordis set up which the vagus inhibition is unable to control. This brings about the arhythmia, loss of efficient contractions, and finally exhaustion with marked diastolic relaxation.

The action of digitalis on the blood-vessels is marked. It causes in therapeutic doses a distinct stimulation of the vasoconstrictors with an increase in the arterial tension. An action on the muscles of the arteries themselves augments this central action, probably antedates it. In poisoning the blood-pressure usually falls, but it is apt to be extremely irregular; final toxic stages are invariably accompanied by loss of pressure, both in the interior and in the extremities.

Nervous System.—This is primarily and markedly stimulated In small doses this action is limited to the medulla in the inhibitory cardiac and vasoconstrictor centers; large doses cause a more extended medullary excitation, with nausea and vomiting, convulsions, and increased respirations; toxic doses induce central motor convulsions, which are not due to cerebral anemia, since they may develop while the circulatory blood-supply is ample.

Absorption and Elimination.—Digitalis is more rapidly absorbed than eliminated, the elimination probably taking place by the kid-

neys. Cumulative action, so called, may take place if the drug is not properly administered.

Kidneys.—Digitalis was introduced into modern practice because of its action as a diuretic.

This diuretic action is due largely to the increase of blood-pressure in the glomeruli of the kidneys, being therefore more pronounced in conditions in which low arterial pressure is maintained at the same time. Very large doses, instead of increasing the amount of urine, may diminish or even wholly suppress it.

Metabolism.—This is increased by reason of the increase in the general circulation. With increased blood-pressure the amount of nitrogen elimination is increased, as is also the quantity of CO_2 given off. If the blood-pressure is not raised by the drug, the increase of these is not noted.

Temperature.—Medicinal amounts have no appreciable effect upon the temperature; large doses cause a reduction of bodily heat in febrile conditions, while toxic doses reduce temperature even in health. The action of digitalis upon the circulatory system is retarded by high temperature.

Eye.—Medicinal amounts have no effect. Large or poisonous doses may cause dimness of vision, amblyopia, diplopia, or mydriasis. In a case of poisoning by digitalis recorded by Jeanton there was xanthopsia for two days.

Uterus.—Large doses stimulate contraction in the uterine muscles.

Untoward Action.—Erysipelatous and papular eruptions have been produced by the drug, there having been also observed nausea and a feeling of weakness in the stomach, dimness of vision, headache, heaviness of the head, sleeplessness, and debility.

Poisoning.—Toxic symptoms may occur either from the ingestion of a single poisonous dose or the accumulation of the drug under prolonged administration.

In the more marked cases of poisoning from overdosage there are marked disturbances of the gastro-intestinal tract, abdominal pains, vomiting and purging. The pulse may at first be slowed down to 40, to be followed in the stage of collapse by a rapid, irregular, and compressible pulse—often imperceptible at the wrist—and syncope, more frequently occurring when the patient is raised up.

Other symptoms are—feeble respiration, dilated pupils and occasionally double vision, headache, delirium and stupor, and possibly convulsions just before death, which result from medullary excitation. Digitalis is not a rapid poison, the fatal collapse being usually deferred from ten to forty-eight hours.

The symptoms indicative of the cumulative action of digitalis are usually gastric irritability, headache, and dizziness. These are associated with a feeling of fulness in the vessels, particularly in the temples, by weakness in the pit of the stomach, and by a tendency to syncope. There may also be ringing and buzzing in the ears, and disturbances of sight and hearing.

Poisonous doses are difficult to determine. One teaspoonful of the leaves, as an infusion, and 40 grains of the powder, have caused death, whereas ten times as much in infusion and 80 grains of the powder have not produced fatal results. The extract in 20-grain doses has been lethal, as have also 2 ounces of the tincture. Digitoxin in $\frac{1}{30}$ grain (.002 Gm.) has been deadly, and the commercial digitalins have caused serious results in doses of from $\frac{1}{2}$–1 grain (.030–.060 Gm.).

Treatment of Poisoning.—Lavage of the stomach should be immediate, emetics being too depressing if the heart is already affected by the poison. A solution of tannic acid should be introduced into the stomach as the best chemical antidote. Diffusible stimulants may be required, the horizontal position should be maintained, and external heat applied, particularly to the abdomen. Absolute rest is imperative. The patient should not be allowed even to raise his hand or his head from the bed.

Therapeutics.—*Externally and Locally.*—Digitalis is of little service externally.

Internally.—DIGITALIS is one of the most important drugs known to medicine. The remedy is indicated in deranged conditions of the circulatory system itself, and, moreover, where, although the circulatory mechanism be normal, an abnormal state of other organs may be improved by changing the circulation in them. Digitalis is indicated in any case where there is actual failure in the dynamic power of the heart-muscle, irrespective of the nature of any primary valvular lesion inducing the hyposystolic condition.

Of course the rational use of the drug presupposes the absence of extensive fatty degeneration or interstitial myocarditis, since, should these conditions be advanced, there is danger of producing permanent asystole. It is difficult to estimate the integrity of the heart-muscle, and many cases presumably intolerant of the drug bear digitalis well.

In all conditions, therefore, in which there is insufficient driving power in the muscle with the usual accumulation of blood in the veins, digitalis is useful. As it improves the blood-supply of its own fibers it therefore aids in restoring tone to itself, and may even so increase its own power as to render the drug unnecessary.

With regard to the specific effect of the drug upon the heart-muscle this is not true, since the influence of the drug lasts but a few days, indirectly, through the additional muscle-power developed during a few weeks' administration. During or after middle life, if the vascular tension be increased, and especially if there be any sclerosis of the vessels, the administration of digitalis should be combined with that of vasodilators, to prevent contraction of the vessels and consequent increase of peripheral resistance. Of these adjuncts, opium is valuable. The nitrites are also of service.

In *mitral regurgitation* digitalis is an exceedingly efficient remedy. In this not infrequent lesion there is a deficiency of

blood in the systemic arteries, and consequently an overaccumulation in the pulmonary vessels and systemic veins. Owing to this venous hyperemia, there is congestion of the lungs, stomach, liver, and the entire digestive tract, together with the attendant symptoms—dyspnea, bronchitis, deranged digestion, constipation, edema, etc.

Digitalis by improving the pumping power of the heart equalizes the circulation, fills the systemic arteries, and relieves the venous congestion with its accompanying symptoms.

Digitalis is valueless in the presence of compensatory hypertrophy, but after *dilatation* occurs is wonderfully effective, the size of the heart being often perceptibly diminished by a proper administration of the drug.

Digitalis may act indirectly as a tonic by improving the nutrition of the heart through the prolonged diastole and contraction of the cardiac muscle it occasions. The longer the period of diastole, the more time is allowed for the coronary arteries to fill and nourish the heart by the better blood-supply. The increased arterial tension produced by the drug causes the blood to be sent into the coronary arteries with greater force during the cardiac diastole.

The forcible contraction of the heart occasioned by this drug expels the blood from the veins of the cardiac muscle, improved nutrition of the muscle resulting from this mechanical action.

There has been some objection to the use of digitalis in cardiac ataxia resulting from *aortic regurgitation*, on the ground that the latter action is more forcible and extensive under its influence. The author's experience is that cases of aortic regurgitation respond to the use of this drug as promptly as any other lesion, save that it is at times necessary to give larger doses than are required in other valvular affections.

In many valvular diseases of the heart there is marked irregularity, such often being more serious than the mere leakage of blood. Digitalis by stimulating the vagus and motor ganglia causes the heart to beat more regularly. The drug is, therefore, of great service in *exophthalmic goiter*.

In any condition of low arterial tension, whether resulting from *infection*, *general debility*, or whatever cause, digitalis, by increasing the force of the heart and raising arterial pressure, serves a useful purpose.

In *collapse from shock*, *poisoning*, or *cholera*, where the great veins are dilated, it has proved an efficient agent, but it must be used in conjunction with more active and quick stimulants, such as alcohol, ether, nitrites, etc.

The functional activity of the various organs in *anemia* and other deranged conditions of the system may be improved by the administration of this remedy.

The circulation being improved, there is increased absorption of fluid from the tissues, as well as greater circulation of fresh intercellular fluid, favoring combustion and functional activity, while the

waste products are more readily removed. This action renders digitalis valuable as a tonic.

In *pneumonia*, particularly if there is an irregular, fluttering heart, and evident signs of toxic action, it is of the greatest importance, being of use here to stimulate the contractile force of the cardiac muscle when the intraventricular pressure becomes stronger than the unaided muscle can resist, and dilatation is imminent, if not already begun.

In *congestion of the lungs* during the course of *exhausting fevers*, such as *typhoid*, and in the first stage of *meningitis*, *bronchitis*, *cellulitis*, etc., before transudation takes place, it is considered by many physicians to be a valuable, remedy in relieving the venous stasis. It is particularly valuable, combined with squill, in many cases of *chronic bronchitis*, particularly of cardiac origin.

Many observers of wide experience have recommended large doses of digitalis in *delirium tremens*. It is wonderfully effective in this condition, particularly where there is low arterial pressure. Small doses are more beneficial than large ones.

Digitalis has been successfully employed in *acute mania* and *epilepsy*, Gowers recommending it in the latter disease as an adjuvant to the bromides, associated with belladonna. It is fair to state that in maniacal conditions the preponderance of testimony is in favor of large doses—½ to 4 fluidrams (1.8–15.0 Cc.) of the tincture.

The drug is thought to enhance the influence of ergot in *post-partum hemorrhage*, and when associated with iron it is of value in *purpura hæmorrhagica*.

The drug, combined with ergot or potassium bromide according to the indications, has been successfully employed in *spermatorrhea*, and *nocturnal emissions*.

It is said that absorption of *pleuritic effusion* is hastened by the continued administration of digitalis.

Clifford Allbutt recommends it in sufficient doses to reduce the pulse to 45 or 50 in *aneurism*. This method of treatment, however, has not been widely adopted.

The remedy is invaluable as a diuretic to relieve *cardiac* or *renal dropsy*, its efficiency being more apparent in the former variety, although acute renal dropsy usually yields to its influence. Digitalis, especially combined with squills, is particularly valuable in all dropsies accompanied by lowered arterial tension. Should the renal structure be impaired, the drug is less serviceable, although, when combined with other appropriate remedies, it is decidedly beneficial in *chronic Bright's disease* with cardiac dilatation. In the early stages of the malady, accompanied by cardiac hypertrophy and high arterial tension, it is doubtful whether digitalis is indicated, either alone or in combination.

In conclusion, it should be stated that digitalis is recommended by all authors in every valvular disease of the heart, with the possible exception of aortic regurgitation, some writers supposing it to be harmful in this condition because of the prolonged diastole it

occasions. The more recent clinical views would seem to show that even this valvular affection is not a contraindication.

Contraindications.—Digitalis should not be given when there is marked degeneration of the heart-muscle or of the arterial walls. In simple hypertrophy, apoplexy, high arterial pressure, or vascular excitement the use of the drug is inadvisable. Many physicians regard aneurism as a contraindication to the use of digitalis.

Administration.—Any of the official preparations may be given, or the powdered leaves in pills or capsules—not at too frequent intervals, however, from four to eight hours elapsing between the doses, lest the drug accumulate in the system, producing poisonous symptoms.

When digitalis has been administered for some time to a patient suffering from ascites, and the fluid is removed by paracentesis, poisoning may ensue. It is well, therefore, to discontinue the remedy for two or three days before tapping the patient.

The rapidity of the drug's action upon the heart depends upon the presence or absence of a febrile state. The stimulant action upon the heart is usually observable in from twenty-four to thirty-six hours. The effects of the drug commonly continue from three to seven days after its discontinuance.

The powdered digitalis, though the most irritant to the stomach, fully represents the drug, which is true of none of the preparations.

The infusion of digitalis, being an aqueous preparation and containing, therefore, a larger proportion of digitonin, is superior for diuretic purposes; while the alcoholic preparations, like the fluid-extract and tincture, being richer in digitalin, digitalein, and digitoxin, are preferable when an action upon the heart is desired.

Ordinarily, therefore, digitalis should be given in solution, the tincture and infusion being the most reliable preparations; care being taken in the selection of the crude drug, upon the character of which the strength of the preparation depends.

In uncomplicated cases of cardiac failure, the result of valvular lesion, the tincture is most eligible. In cardiac failure associated with, or resulting from, kidney lesions the infusion, combined with some other diuretic, should be used.

As to the cumulative effect of digitalis, so much feared by the older writers on its action, the evil may be ascribed to improperly selected cases or faulty administration. Under proper conditions the drug may be given for months without ill effect.

Of the active constituents, digitalin is usually preferred, as it is so quickly soluble that its effects are manifested a few minutes after its administration, it possesses the full power of digitalis in its influence on the heart, with a minimum of its vasoconstrictor action.

Strophănthus—Strophănthi—Strophanthus. U. S. P.

Origin.—The ripe seed of *Strophanthus Kombé* Oliver, deprived of its long awn. The plant is a woody climber, ascending to the tops of high trees, from which it hangs in festoons. It is found in tropical Africa, where it and other species of strophanthus are used to prepare arrow-poisons termed *kombé*, *Inee*, *Inege*, etc.

Description and Properties.—The seeds are about ⅝ inch (15 Mm.) long and ⅙ to ⅕ inch (4–5 Mm.) broad, oblong-lanceolate, flattened and obtusely-edged, grayish-green, covered with appressed silky hairs, one side extending into the attenuated, pointed end; kernel white and oily, consisting of a straight embryo having two cotyledons, and surrounded by a thin layer of perisperm; nearly inodorous; taste very bitter.

Many of the species of strophanthus contain a glycoside, *strophanthin*, upon which their medicinal properties depend. Feist has also isolated a pseudostrophanthin. Stroph anthidin is also described as a separate glycoside found in some of the seeds. It also contains kombic acid. Another active principle, *ouabaïn*, is obtained from a related species of strophanthus.

Dose.—1 grain (0.065 Gm.), U. S. P.

Official Preparation.

Tinctūra Strophănthi—Tinctūræ Strophănthi—Tincture of Strophanthus (10 per cent.).—*Dose*, 2–10 minims (0.12–0.6 Cc.) [8 minims (0.5 Cc.), U. S. P.].

Strophanthīnum—Strophanthīni—Strophanthin. U. S. P.

Definition.—A glucoside, or mixture of glucosides, obtained from strophanthus.

Description and Properties.—Strophanthin is a white or faintly yellowish crystalline powder. It is permanent in the air and has an intensely bitter taste. It is very soluble in water and diluted alcohol. Its solutions decompose very readily.

Dose.—Average dose: $\frac{1}{200}$ grain = 0.0003 Gm. (0.3 milligramme), U. S. P.

Antagonists, Incompatibles, and Synergists.—The same as for digitalis.

Physiological Action.—*Externally and Locally.*—The tincture of strophanthus has no local action of importance. Strophanthin and ouabaïn, however, possess marked sedative properties, the latter being much the stronger. They paralyze the ends of the sensory nerves and are active local anesthetics.

Internally.—Digestive System.—Strophanthus is similar in its action to digitalis, though less apt to disturb digestion in small doses; on the contrary, its bitter taste tends to improve the appetite.

Circulatory System.—Upon the heart its action is identical with that of digitalis, though differing from the latter drug in its effect upon arterial tension and the arterioles. Strophanthus does not contract the arterioles so markedly, and the arterial pressure is but slightly raised, the elevation being due to the increased force of the heart. Its action is more rapid than that of digitalis, results being produced in fifteen to twenty minutes after taking.

Nervous System.—Strophanthus affects the nervous system even less than digitalis. Kobert claims that it is a slight sedative to the brain and spinal cord.

Respiratory System.—It has no important action.

Absorption and Elimination.—Strophanthus is rapidly absorbed, and more readily eliminated than digitalis, possessing less cumulative action. It is principally excreted by the kidneys, increasing the amount of urine by the strengthened heart's action. Unlike digitalis, the drug has little influence upon the caliber of the renal vessels.

Temperature.—Very large doses of strophanthus cause a slight reduction of temperature, not, however, as marked as digitalis.

Eye.—Excessive doses contract the pupil and increase intraocular tension.

Uterus.—It resembles digitalis, though more feeble in its action upon the uterus.

The symptoms and treatment of *poisoning* are similar to those described under Digitalis, although strophanthus is more apt to occasion diarrhea. Cases of poisoning are rare. The symptoms observed have been those of severe digitalis poisoning with unconsciousness, tonic and clonic convulsions, hallucinations, diarrhea, analgesia, myosis, Cheyne-Stokes respiration, and death after four days. The toxic dose has not been determined.

Therapeutics.—*Externally and Locally.*—STROPHANTHIN has been occasionally employed as a local anesthetic, but the testimony in its favor is hardly sufficient to encourage its use.

Internally.—STROPHANTHUS is a cardiac remedy, being indicated in the same varieties of heart disease as digitalis. It is of particular value in *stenosis of the mitral orifice*, having a happy influence in controlling the irregular rhythm, nervous dyspnea, and intermittent pains distinctive of this lesion. The drug is also well adapted in subduing functional irregularities of rhythm in cases of *irritable* or *tobacco heart.*

Hypothetically, STROPHANTHUS is superior to digitalis in certain stages of *Bright's disease* and *heart failure* of elderly people with slightly degenerated arteries, especially in those patients with pre-existing high arterial tension. It is also hypothetically of greater value in pneumonia than digitalis.

Shoemaker advocates the use of strophanthus in the treatment of *psoriasis.*

While in the majority of cardiac diseases digitalis should be first tried, where it fails strophanthus is the proper recourse. It is a peculiarly efficient drug in the *cardiac diseases of children*, according to the majority of observers being safer than digitalis for young patients.

Contraindications.—The same as for digitalis.

Administration.—Of the preparations of strophanthus, the tincture is preferable, both for convenience and safety. It should not be forgotten, however, that the seeds of strophanthus that come into the American market are very much mixed, and that many preparations are not as reliable as one would hope for. Should strophanthin or ouabaïn be desirable, a fresh solution is to be preferred.

Convallāria—Convallāriæ—Convallaria. *U. S. P.*

(LILY OF THE VALLEY.)

Origin.—The dried rhizome and roots of *Convallaria majalis* L., a stemless perennial indigenous in Europe, Northern Asia, and North America.

Description and Properties.—Of horizontal growth and somewhat branched, about ⅛ inch (3 Mm.) thick, cylindrical, wrinkled, whitish, marked with a few circular scars; at the annulate joint with about eight or ten thin roots; fracture somewhat fibrous, white; odor peculiar, pleasant; taste sweetish, bitter, and somewhat acrid.

Convallaria contains two glycosids: *convallamarin* and *convallarin.*

Official Preparation.

Flūidextrăctum Convallāriæ—Flūidextrăcti Convallāriæ—Fluidextract of Convallaria.—*Dose*, 5–30 minims (0.5–2.0 Cc.) [8 minims (0.5 Cc.), U. S. P.].

Antagonists and Incompatibles.—The antagonists are the same as for digitalis; tannic acid precipitates the convallamarin.

Synergists.—The cardiac stimulants enhance its cardiac action; emetics and cathartics aid its emeto-cathartic effects.

Physiological Action.—Almost identical with that of digitalis, but less powerful and possessing no cumulative action. Preparations free from convallarin do not disturb the stomach nor affect the cerebrospinal functions. It is asserted that convallaria has stronger diuretic properties than digitalis.

Convallamarin in some cases has produced, among other untoward symptoms, hemoptysis and dyspnea.

Convallarin is a drastic purgative, and in full doses occasions nausea and gastric pain.

Therapeutics.—CONVALLARIA is used for precisely the same purposes as digitalis. The only advantage it possesses over the latter drug is that it has no cumulative action. By some physicians it is considered superior to digitalis as a diuretic and cardiac stimulant after failure of compensation, the diuresis it occasions persisting for some time after the withdrawal of the drug.

Contraindications.—The same as for digitalis.

Administration.—The fluidextract is the best preparation to use, although the infusion is highly recommended by many physicians. Convallamarin replaces digitalin in its action and uses, but does not disturb the stomach like digitalis, and is slightly laxative. It may be used an alterant with digitalin in doses of $\frac{1}{12}$ grain (0.005 Gm.).

Adōnis Vernālis—Adŏnidis Vernālis—False Hellebore. (*Non-official.*)

Origin.—A perennial herb attaining a height of about 10 inches (25 Cm.), indigenous in Europe.

Description and Properties.—It has but little odor and a somewhat acrid and bitter taste. The plant contains a glucosid, *adonidin*, to which it owes its medicinal properties. This constituent is a light-colored, crystalline powder, of a bitter taste, and soluble in water and alcohol. A Japanese species, *Adonis amurensis*, yields a related glucoside, *Adonin.*

Dose of Adonidin.—$\frac{1}{20}$–$\frac{1}{6}$ grain (0.003–0.01 Gm.).

Antagonists, Incompatibles, and Synergists.—The same as for digitalis.

Physiological Action and Therapeutics.—The action of adonidin is similar to that of digitalis, save that it is less cumulative.

It is used for the same purposes as digitalis, being peculiarily valuable in relieving the pains of heart disease, and is by some physicians preferred to digitalis in the treatment of *aortic* and *mitral insufficiency*, *cardiac asthma*, and *functional irregularity of the heart.*

Scopārius—Scopārii—Scoparius. *U. S. P.*

(BROOM.)

Origin.—The dried tops of *Cytisus scoparius* L., a shrub 3 to 6 feet (0.9–1.8 M.) high, found in Western Siberia and the greater part of Europe. It is sometimes cultivated, and is occasionally met with wild in some of the Middle and Southern States.

Description and Properties.—Occurring in thin, flexible, branched twigs, pentangular, winged, dark green, nearly smooth, tough, usually free from leaves; odor peculiar when bruised; taste disagreeably bitter.

The constituents of scoparius are *sparteine*, a pyridine alkaloid, similar in composition to coniine, and a neutral, crystalline principle, *scoparin*, to which the diuretic action of the drug is thought to be due.

Dose.—½–1 dram (2.0–4.0 Cc.) in infusion [15 grains (1 Gm.), U. S. P.].

Official Preparation.

Sparteīnæ Sŭlphas—Sparteīnæ Sulphātis—Sparteine Sulphate.—The sulphate of an alkaloid obtained from scoparius.

Description and Properties.—Colorless, white, prismatic crystals, or a granular powder, odorless, and having a slightly saline and somewhat bitter taste; liable to attract moisture when exposed to damp air; very soluble in water and alcohol.—*Dose*, $\frac{1}{20}$–2 grains (0.003–0.1 Gm.) [⅛ grain (0.01 Gm.), U. S. P.].

Antagonists and Incompatibles.—The antagonists are the same as for digitalis, and tannic acid and potassium iodide are incompatibles.

Synergists.—Digitalis, strophanthus, etc.

Physiological Action.—*Externally and Locally.*—No action observed.

Internally.—Digestive System.—Sparteine sulphate acts like bitters in improving the appetite and digestion, large doses, as with digitalis, producing vomiting and purging.

Circulatory System.—Cushny and Matthews claim that the action of sparteine upon the heart and blood-vessels is similar to that of digitalis, and numerous experiments upon animals show that while the drug has a slowing action on the heart, it is not of the type induced by the action of digitalis—*i. e.*, muscle irritation and vagus stimulation.

Nervous System.—Sparteine resembles coniine in its action upon the nervous system, depressing the brain and spinal cord, and lowering reflex action through paralysis of the motor nerve-endings. Under toxic doses there is also extreme muscular weakness, often complete paralysis.

Respiratory System.—Medicinal doses produce no effect. Toxic

doses slow and weaken the respiration, death being possible from paralysis of muscles of respiration and asphyxia.

Absorption and Elimination.—It is rapidly absorbed and as readily eliminated, and, unlike digitalis, has no cumulative action. In disease it is an active diuretic, particularly the infusion or fluidextract or the alkaloid scoparin. Sparteine, on the other hand, is not an active diuretic.

Scoparius therefore increases the flow of urine and the excretion of urea. The drug has a direct action upon the renal structure.

Poisoning.—The following symptoms occur: Small, rapid, and irregular pulse, dyspnea, great muscular weakness, incoördination of movement, and muscular tremors, followed possibly by clonic and tonic convulsions, which are replaced by marked depression of the nervous and muscular system, and collapse.

Treatment of Poisoning.—Respiration should be maintained by artificial respiration and by hypodermic injections of strychnine and atropine. Potassium iodide or solutions of tannic acid should be given, and the free use of diuretics or diluents to favor elimination.

Therapeutics.—*Externally and Locally.*—No influence is exerted.

Internally.—SCOPARIUS was formerly used for the same purposes as digitalis. It is serviceable in some cases of *nephritis* with weak, irregular heart-action, and in *chronic Bright's disease* with cardiac hypertrophy and high arterial tension. It is also useful in the nervous, irregular heart of opium habitués. It is also valuable as a diuretic. Like strophanthus, scoparius is of more value in mitral than in other valvular diseases. The drug, while having many enthusiastic advocates, is generally less esteemed than digitalis.

Contraindications.—Practically the same as for digitalis, though less definite.

Administration.—The fluidextract of scoparius may be given or the decoction, made by adding ½ an ounce (16.0 Gm.) of the broom-tops to 1 pint (½ liter) of water and boiling them down to ½ pint (250 Cc.). Of this, 1 ounce (32.0 Cc.) should be taken every three hours. This decoction is one of the most efficient diuretics in cardiac dropsy.

The sparteine sulphate is usually employed when an action on the heart is desired; it may be administered either hypodermically or in pill, capsule, or aqueous solution.

Căctus—Căcti—Cactus—Night-blooming Cereus.
(*Non-official.*)

Origin.—The stems and flowers of *Cactus grandiflorus* L., a plant indigenous in tropical America and frequently cultivated for ornament.

Preparations.

Flūidextrăctum Căcti—Flūidextrăcti Căcti—Fluidextract of Cactus.—*Dose*, 5–10 minims (0.3–0.6 Cc.).

Tinctūra Căcti—Tinctūræ Căcti—Tincture of Cactus.—*Dose*, 15–20 minims (1.0–1.2 Cc.).

Physiological Action and Therapeutics.—Cactus differs from digitalis in its less disturbing influence upon the digestive apparatus. Its action upon the circulation is to elevate arterial pressure, render the pulse more regular, and increase the strength and rapidity of the heart's action when given in medicinal doses. Toxic doses, on the contrary, diminish both the blood-pressure and the pulse-rate, rendering the heart irregular in its action and arresting it in systole. Moreover, the reflexes are increased by poisonous doses, death being preceded by clonic and tetanic convulsions of spinal origin.

Cactus helps to steady the distended heart, especially when there is a neurotic element, and is of particular service in relieving precordial distress of myopathic origin. It is useful in functional irregularity of the heart however evidenced. In "tobacco heart," cardiac arrhythmia and palpitation of neurasthenia, and the distressing palpitation from reflex irritation in dyspepsia, cactus is a valuable remedy. In organic disease of the heart cactus, if less generally applicable, is none the less valuable, for it seems to afford the greatest service just where digitalis and strophanthus fail.

DRUGS ACTING CHIEFLY AS VASOCONSTRICTORS.

A number of the group of drugs whose main action is on the organs of circulation act, in some respects, like the digitalis group, but instead of exerting their main action on the heart-muscle, their chief activity is manifest on the arteries and unstriped muscle in general. The most important of this series are ergot and the suprarenal extracts. Hydrastis and gossypium may be included in this category, but their action is much weaker.

Ergōta—Ergōtæ—Ergot. *U. S. P.*

Origin.—The sclerotium of *Claviceps purpurea* (Fries) Tulasne (Fungi), replacing the grain of rye, *Secale cereale* L. Most of the commercial article comes from Spain and Russia.

Description and Properties.—Somewhat fusiform, obtusely triangular, usually curved, about ¾ to 1¼ inches (2–3 Cm.) long and ⅛ inch (3 Mm.) thick; three-furrowed, obtuse at both ends, purplish-black, internally whitish, with some purplish striæ, breaking with a short fracture; odor peculiar, heavy, increased by trituration with potassium or sodium hydrate T. S.; taste oily and disagreeable. Old ergot, which breaks with a sharp snap, is almost or entirely devoid of a pinkish tinge in the fracture, is hard and brittle between the teeth, and comparatively odorless and tasteless, should be rejected.

Ergot should be but moderately dried and preserved in a closed vessel, with a few drops of chloroform added from time to time to prevent the development of insects. When more than one year old it is unfit for use.

The active constituents of ergot are not definitely ascertained. It contains, however, an acid soluble in water and variously termed *sclerotinic*, *ergotinic*, and *ergotic* acid, and another, soluble in alkalies, known as *sphacelic* acid. Both of these acids possess ecbolic properties. Kobert isolated a principle known as *cornutine*. 30 per cent. of a yellow non-drying saponifiable fixed oil, besides proteids, sugar, tannin, and ash are also present. The commercial ergotin is merely a purified aqueous extract of ergot.

Jacobj has more recently isolated two bodies: one, *sphacelotoxin*, which produces gangrenous effects, and *chrysotoxin*, which acts somewhat like Kobert's cornutine.

Dose.—5–60 grains (0.30–4.0 Gm.) [30 grains (2 Gm.), U. S. P.].

Official Preparations.

Extrāctum Ergōtæ—Extrācti Ergōtæ—Extract of Ergot.—*Dose*, 2–10 grains (0.12–0.6 Gm.) [4 grains (0.25 Gm.), U. S. P.].

Flūidextrāctum Ergōtæ—Flūidextrācti Ergōtæ—Fluidextract of Ergot.—*Dose*, 15–60 minims (1.0–4.0 Cc.) [30 minims (2 Cc.), U. S. P.].

Vīnum Ergōtæ—Vīni Ergōtæ—Wine of Ergot.—*Dose*, 1–3 fluidrachms (4.0–12.0 Cc.) [2 drachms (8.0 Cc.), U. S. P.].

Antagonists and Incompatibles.—The cardiac and motor depressants antagonize the action of ergot. Caustic alkalies and metallic salts are chemically incompatible.

Synergists.—Its action upon the circulation is aided by digitalis and belladonna; upon the nervous system by strychnine; while ustilago, hydrastine, gossypium, and the emmenagogues enhance its influence upon the uterus.

Physiological Action.—*Externally and Locally.*—Ergot has no distinctive action upon the skin, but upon mucous membranes its influence is that of an astringent, possessing hemostatic properties.

Internally.—Digestive System.—In large doses it is a gastro-intestinal irritant, occasioning considerable heat and dryness of the throat, accompanied by thirst and succeeded by pain in the stomach and bowels, vomiting, and occasionally purging, with violent peristalis, although constipation is the commoner sequence.

Circulatory System.—Repeated medicinal doses increase the blood-pressure and render the pulse slower and smaller, the result principally of stimulation of the vasomotor center in the medulla, with possibly some influence upon the heart or the walls of the arterioles. Jacobj thinks that sphacelotoxin is the chief agent in causing the contraction of the arteries, and that its activities are exerted both centrally and peripherally.

The heart muscle itself seems to be stimulated secondarily only.

Nervous System.—Medicinal doses have no especial action, though excessive doses sometimes depress the sensory mechanism, producing general cutaneous anesthesia.

The action of toxic doses on the nervous system will be described under "Poisoning."

Medulla.—Ergot has a distinct action on the medulla, stimulating the respiratory and cardio-inhibitory centers, and acting as a distinct stimulant to the vasoconstrictor apparatus. Its action on circulation is thus marked.

Respiratory System.—Medicinal doses produce a mild stimulation of the respiratory center.

Absorption and Elimination.—The actual constituents of ergot are rapidly absorbed into the blood, and are eliminated principally by the kidneys, increasing the urinary flow.

Temperature.—No special action has been observed.

Eye.—The caliber of the retinal and nutrient opticus blood-vessels is reduced, resulting in marked pallor of the disk, transitory amblyopia, and papillary anemia.

Uterus.—Probably the most important action of ergot is upon

this organ. It produces in full doses tetanic, tonic contraction of the uterine muscle, the uterus becoming hard and pale, and forcing the blood out of the uterine arterioles. The organ is more sensitive to the action of the drug during pregnancy.

The precise manner in which ergot affects the uterus is still a matter of discussion. It is fairly demonstrated, however, that the drug acts both centrally and peripherally.

It is doubtful if any drug in our Materia Medica has been more carefully studied than ergot, and, if opinions differ widely as to its *modus operandi*, it is because we have to deal with a very complex substance, the nature, and even the number, of whose constituents are as yet inadequately known. Many principles of the drug are unstable and variable in their action, certain preparations differing decidedly from others in their influence, as, for instance, Tanret's ergotinine, which has no effect upon the uterus. Bonjean's ergotin is a powerful ecbolic, and has a marked action, moreover, upon the vascular system, whereas Wigger's ergotin is inert. Kobert's cornutine is probably not a pure principle, and his ergotinic acid is not a true principle. Jacobj's principles are those last isolated.

Untoward Action.—In addition to the gastro-intestinal disturbances already described, there are occasionally produced headaches, mental confusion, dizziness, a feeling of chilliness, muscular weakness, dilatation of pupils, and glimmering before the eyes.

Poisoning.—There are two varieties of ergot-poisoning, acute and chronic. Under the administration of immoderate doses peculiar symptoms appear, known collectively as *acute ergotism*. Restlessness, mental worry, headache, tinnitus aurium, dilatation of the pupils, pallor and coldness of the skin, and other effects are present. There is a weak, slow pulse and evident symptoms of respiratory failure. At times cutaneous anesthesia is manifest, or general formication. There may be disturbances of vision and of hearing. Epileptiform spasms, great reduction of respiration and temperature may occur, while obstruction of cardiac movements, with sudden nausea, salivation, violent vomiting, and intense diarrhea, and other alarming manifestations, attest the untoward properties of the drug. In pregnant women colic, abortion, and hemorrhage may occur. Death may take place at the end of about twenty-four hours, but the dose must be enormous. Sixty grains of ergot have produced very severe symptoms. As most of the acute poisonous cases have been complicated by abortion and hemorrhage, the lethal dose is difficult to estimate. Proportions of over 2 per cent. of ergot in rye flour may cause acute intoxication.

Chronic ergotism is confined chiefly to Europe, where ergotized rye is used in bread-making. The disease is marked by convulsive or grangrenous conditions. Numerous irregular types are observed.

The first variety, the convulsive, is characterized by paroxysmal spasms of the flexor muscles, which later become continuous, resulting in opisthotonos or emprosthotonos. There is dimness of vision, while an increasing intensity of symptoms develops affections

of other special senses, those of hearing and smell being either impaired or temporarily lost. Violent abdominal cramps also occur, together with painful dyspnea, death resulting from asphyxia or coma.

The second (gangrenous) form is signalized by severity of local phenomena, profound dyscrasia, formication or cutaneous anesthesia, impairment of special senses, and numbness of the muscles or extremities, followed by sloughing or atrophy of the diseased parts and mummification, or dry or moist gangrene.

Fatal results of chronic ergotism are usually traceable to the convulsions, although moist or dry gangrene may in certain cases produce death.

A form of ergotism is described in Lombardy, Italy, occasioned by chronic poisoning with diseased or fermented maize, and affecting principally the cerebrospinal and digestive systems. It causes an acute erythema, which extends rapidly and is attended with much swelling, together with an extreme sensation of burning or itching. Pronounced nervous and general symptoms are present, and the malady not infrequently results in insanity or melancholia. Locomotor-ataxia-like symptoms are also encountered when the vessels of the cord are involved.

Treatment of Poisoning.—Symptoms of acute poisoning may be alleviated by hot baths and the administration of tannic acid and cardiac stimultants. For the treatment of chronic ergotism hygienic measures and symptomatic remedies are indicated.

Therapeutics.—*Externally and Locally.*—In the form of lozenges or diluted FLUIDEXTRACT the drug has been employed in *acute pharyngitis*. The hypodermic injections of Bonjean's ERGOTIN are valuable in *nasal hypertrophies*, *prolapsus of the rectum*, *hemorrhoids*, *enlargement of the prostate gland*, *aneurism*, *varicocele*, and *varicose veins*.

Internally.—The most important medical use of ERGOT is to promote uterine contractions in labor. The preponderance of testimony among the most experienced obstetricians is in favor of its use only after the expulsion of the uterine contents. This is a rule, however, which cannot be invariably followed. While the employment of the drug is contraindicated in the *first stage* of labor, it may be safely employed during the second stage, when there is uterine inertia, provided all the parts be in a normal condition and there exists no mechanical impediment to the rapid delivery of the child. Ergot is of service also when the placenta is retained owing to inefficient and feeble uterine contractions.

No drug possesses so energetic and prompt an action as ergot in *postpartum* and *uterine hemorrhage*. It is an exceedingly efficacious remedy also in *subinvolution* and in *uterine fibroids* and *polypi*.

This remedy is also extremely useful in the treatment of *plethoric amenorrhea*, *congestive dysmenorrhea*, *menorrhagia*, *chronic metritis*, etc.

DILATATION OF THE CARDIAC CAVITIES without valvular lesion is

much improved by the administration of ergot; the remedy has also been employed with considerable success in *chronic diarrhea* and *dysentery*.

Incontinence of urine—depending either upon enlarged prostate, irritability, or a paretic or paralytic condition of the bladder—is greatly relieved by this remedy. The atonic form of *spermatorrhea* is palliated or cured by ergot.

The drug is of value also in *cerebral hyperemia* and consequent *mania*, as well as in *cerebrospinal meningitis*, *congestion of the spine*, *myelitis*, and *congestive headaches*.

Ergot has been highly recommended, notably by Dr. J. M. Da Costa, in *diabetes insipidus*, and by such authorities as Heltzmann and D'Enslow in *prurigo*, *erythema*, *urticaria*, and *acne rosacea*.

Owing to the peculiar action of ergot upon unstriped muscular fiber it is a valuable drug in various forms of *hemorrhage*.

Finally, this remedy has met with some success in the treatment of *leukorrhea*, *galactorrhea*, *hypostatic congestion of the lungs*, *whooping cough*, the different varieties of *purpura*, *colliquative sweats*, *splenic enlargements*, and *exophthalmic goiter*. In the hands of many practitioners ergot is of great value in the treatment of alcoholism and morphinism.

Contraindications.—During the first stage of labor and in cerebral or spinal anemia.

Administration.—For its action upon the uterus a valuable fluidextract is the best preparation as an internal remedy; for hypodermic use of the aqueous extract (Bonjean's ergotin) or some of the non-alcoholic fluid preparations manufactured by certain reliable pharmacists for this particular purpose, should be employed. Ergotin may be incorporated in suppositories when for any reason it is desirable to administer the drug *per rectum*.

Gossўpii Cŏrtex—Gossўpii Cŏrticis—Cotton-root Bark. *U. S. P.*

Origin.—The dried bark of the root of *Gossypium herbaceum* L. and of other species of the genus, indigenous in the tropical and subtropical regions of Asia and Africa. The plant has been cultivated in the United States and other countries from a very early period, many characteristic varieties having been produced.

Description and Properties.—It occurs in thin, flexible bands or quilled pieces, the outer surface brownish-yellow, with slight longitudinal ridges or meshes, small, black circular dots, or short, transverse lines, and dull, brownish-orange patches, from the abrasion of the thin cork; inner surface whitish, of a silky luster, finely striate; bast-fibers long, tough, and separable into papery layers; inodorous; taste very slightly acrid and faintly astringent.

It contains a fixed oil, a small quantity of tannin, sugar, and starch, a yellow resin, and, in the fresh bark, a pale-yellow chromogene, soluble in alcohol, which on exposure to air becomes red and resinous.

Dose.—15–60 grains (1.04–4.0 Gm.) [30 grains (2 Gm.), U. S. P.].

Antagonists and Incompatibles.—The same as for ergot.

Synergists.—Ergot and its synergists.

Physiological Action.—Resembling ergot somewhat, but inferior in certainty of action.

Therapeutics.—Cotton-root bark is employed only for its action upon the uterus. An exception may possibly be in its use in the treatment of *subinvolution* and *tumors of the uterus*, in which cases it is less efficient than ergot. The drug is very unreliable, many pharmacologists claiming that it has no action on the uterus whatever.

Contraindications.—The same as for ergot.

Administration.—The fluidextract only should be employed.

Glandūlæ Suprarēnales Sĭccæ—Glandulārum Suprarenālium Siccārum—Desiccated Suprarenal Glands. *U. S. P.*

Definition.—The cleaned, dried, and powdered suprarenal glands of the sheep or ox, freed from fat.

Description.—A light, yellowish, amorphous powder, having a slight characteristic odor; partially soluble in water. 1 part of the dried glands represents approximately 6 parts of fresh glands. Aqueous extracts of the glands rapidly deteriorate on keeping and should, therefore, be freshly prepared.

Dose.—Average dose: 4 grains (0.250 Gm. = 250 milligrammes), U. S. P.

Researches by Abel and Crawford first demonstrated the presence of an active principle. This they extracted in an impure form and termed it *epinephrine*. Takamine, by a different process, also extracted the principle and applied the name *adrenalin*.

In commerce the principle is sold under the names of adrenalin, suprarenin, suprarenalin, adnephrin, epinephrine, epirenan, hemisine, etc. Probably few of the bodies are pure.

Epinephrine is a nitrogenous body. Its structure is not definitely known, but it is thought to resemble the pyrrhol derivatives, particularly skatol.

Epinephrine itself as first isolated by Abel and Crawford is so unstable that it has not been possible to give it a satisfactory description. Its salts, sulphates, and hydrochlorides are more satisfactory. The sulphate is a hygroscopic, straw-colored residue, which tends to crystallize on standing over sulphuric acid. Agglomerated groups of small crystals form on the edge of the receptacle, and the entire residue takes on a semicrystalline appearance. *Adrenalin* is a more stable compound.

Physiological Action.—With aqueous solutions of fresh specimens of the dried gland or with solutions of the salts this drug has a marked action on mucous membranes. A few drops of the solution act as a rapid and strong astringent, whitening the mucous membrane by stimulating the contractile muscles of the blood-vessels. This action is local, and is manifest in the mucous membranes of the conjunctivæ, nares, pharynx, membrana tympani, vagina, urethra, and rectum. The parts to which it is applied are rendered practically bloodless. This action persists for from fifteen minutes to half an hour following a single application. Partial anesthesia may occur. Repeated applications do not seem to cause

paralysis of the blood-vessel, but often following the application an extreme secondary dilatation may occur.

When administered by the mouth, some of the systemic effects of the drug may be developed, but it is by subcutaneous injection or intravenous infusion that the systemic effects are best brought out. In general, these resemble those produced by the glucosides of the digitalis group. The heart action is rendered more forcible by direct muscular stimulation; the rate is decreased by stimulation of the vagus centers; and there is a very rapid and extreme rise in the blood-pressure, due to at least three elements—the strengthening of the heart's contractions, marked general direct contraction of the muscular fibers, and a stimulation of the vasomotor centers.

It has been observed that the pulmonary and cerebral vessels, and to a slight extent the vessels of the muscles, are less influenced than are the other vessels of the body. The retinal vessels have been observed to be dilated. The vessels of the abdominal organs are most influenced.

The most potent factor in this constriction of blood-vessels is probably the direct irritant action of the drug on smooth muscle fibers, for throughout the body this tissue is decidedly stimulated. The pupil dilates, the intestines are stimulated to greater peristaltic activity, and the uterus contracts.

In fact it has been demonstrated that as weak a solution as 1 : 20,000,000 of adrenalin in water will cause the uterus of a gravid rabbit to contract with great vigor.[1] Adrenalin may cause abortion in rabbits if injected into the body of the uterus.

The secretions, particularly of the saliva, tears, and bile, are stimulated, and adrenalin, by injection or by painting on the pancreas, exerts a distinct action on the pancreatic function, causing glycosuria (Herter). The cause of adrenalin glycosuria is not yet positively known.

Therapy.—This is still in its infancy.

The suprarenal extract should be freshly prepared, its active principle being weakened by heat and preservation. It is the most powerful astringent known, a single drop of a 1 per cent. solution instilled into the eye resulting in a whitening of the conjunctiva and lids in from two seconds to forty minutes. It is useful in all forms of inflammation of the eye, whether traumatic, infectious, or proceeding from constitutional diseases, such as rheumatism, syphilis, or tuberculosis. The pupil is not contracted by it, and tolerance is not established by its use. It possesses neither antiseptic nor anesthetic properties, the rapid cures attending its employment being entirely due to its blood-constricting influence.

In suppurative otitis and dry catarrh the extract is often valuable in relieving congestion. By it tinnitus is permanently relieved. It lessens the congestion of turbinated bodies immediately, often benefiting catarrhal affections when cocaine and other astringents fail. It reduces the congestion of an inflamed eye sufficiently to

[1] Kurdinowsky, "On Isolated Uterus of Pregnant Rabbits," *Arch. f. Gyn.*, lxxii., No. 2.

permit cocaine anesthesia. It has been found efficacious in relieving various strictures, as of the nasal duct, the urethra, and the esophagus.

Velich found that the extract occasions local anemia when applied to the skin, not only where there is a lesion, but also where the cuticle is unbroken. It has been used to whiten an eczematous patch and to prevent vesiculation. Dr. Douglas Stanley found that in one case of pernicious anemia the freshly prepared aqueous extract produced a marked increase in the number of red corpuscles. It is valuable in Addison's disease (Osler), and is a tonic to the heart-muscles (Oliver and Schäfer), "the tension being enormously increased by intravenous injections," though its action is less marked in subcutaneous use, and is uncertain when administered *per os*. It is much more rapid and distinct in its vessel-constructing action than either digitalis or ergot, but also very evanescent.

Its field of usefulness as a local astringent has not yet been fully explored. In nasal operations it renders the field of operation bloodless, and there is no reason why it cannot be used, when rendered aseptic, in abdominal or brain surgery, especially where continous oozing is a bar to good technic.

The field for its systemic use will probably widen. It is a powerful heart tonic, and is particularly to be recommended in poisoning by those drugs that cause vasomotor paralysis, notably chloroform and chloral, and in threatened heart failure its use is to be commended. Addison's disease, confessedly related to the suprarenal gland in some obscure manner, may in time be benefited by its use, but as yet no markedly encouraging progress has been made in this direction.

It has been of service in some cases of gastric hemorrhage, and may be tried in typhoid, but it is doubtful whether its secondary action may not prove harmful in this connection.

The general toxicity of adrenalin seems more marked in men than in some animals, suggesting a special sensitiveness to it on the part of the human organism.

Owing to the vascular lesions which are produced by the intravenous and intratracheal injections, and for other reasons, these methods should be rejected from practice. As regards hypodermic injections, however, authorities seem to be in accord that they are not followed by vascular alterations. Nevertheless, taking into consideration the very great sensibility to adrenalin exhibited by the human subject, it is advisable not to continue the administration of the drug over a long period, no matter by what route it is introduced. In fact, it is not considered prudent to give adrenalin for more than ten days at a time at the outside limit. In the author's opinion the dose as given is too large. A dose of one-half to one milligramme in the twenty-four hours is sufficient.

There are certain distinct contraindications: (1) when the arterial tension is already elevated; (2) when the cerebral arteries are brittle or degenerate, and (3) when there is an arterial aneurism.

XANTHINE DERIVATIVES.

Caffēina—Caffēinæ—Caffeine. U. S. P.

Origin.—A feebly basic substance [$C_5H(CH_3)_3N_4O_2 + H_2O$], obtained from the dried leaves of *Thea Sinensis* (tea) L., or from the dried seeds of *Coffea Arabica* (coffee) L., and found also in other plants.

It may also be prepared synthetically from theobromine by the introduction of a third methyl group.

Description and Properties.—Fleecy masses of long, flexible, white crystals, having a silky luster, without odor and of a bitter taste; permanent in the air; soluble in 80 parts of water and 33 parts of alcohol.

Dose.—2–5 grains (0.12–0.3 Gm.) [1 grain (0.065 Gm.), U. S. P.].

Official Preparations.

Caffēina Citrāta—Caffēina Citrātæ—Caffeine Citrate.—*Description and Properties.*—A white powder, odorless, having a purely acid taste and an acid reaction. One part of citrated caffeine forms a clear, syrupy solution with about 3 parts of water.

Dose.—2–5 grains (0.12–0.3 Gm.) [2 grains (0.125 Gm.), U. S. P.].

Caffēina Citrāta Effervēscens—Caffēinæ Citrātæ Effervescēntis—Effervescent Citrated Caffeine.—*Dose,* 1–4 drachms (4.0–16.0 Gm.) [60 grains (4 Gm.), U. S. P.].

Antagonists and Incompatibles.—Cerebral and cardiac depressants antagonize the action of caffeine.

Synergists.—Members of this group and the cerebral and motor excitants. The action of caffeine upon the digestive tract may be enhanced by the vegetable bitters.

Physiological Action.—*Externally and Locally.*—Caffeine possesses no very important local action, though freshly roasted coffee is slightly analgesic and deodorant—a property due to the empyreumatic oils developed by roasting rather than to the caffeine which it contains.

Internally.—Digestive System.—In moderate amounts caffeine, like tea and coffee, stimulates the appetite, improving the digestion, and relieving the sense of plenitude in the stomach. All of them increase peristalsis and (particularly coffee) act as mild laxatives and slightly stimulate the secretion of bile.

Immoderate and continued dosage of caffeine or the excessive use of tea and coffee profoundly disturbs the digestive function, resulting in gastric catarrh, indigestion, hepatic congestion, constipation, and hemorrhoids. Tea, by reason of the high percentage of tannin contained, frequently causes constipation.

Circulatory System.—Medicinal doses of caffeine strengthen and quicken the heart's action. The rapidity of the heart's action is increased, shortening the diastolic period, the drug in this respect differing from digitalis; at the same time the arterial pressure is elevated.

The precise *modus operandi* of caffeine in its action upon the circulatory system is still a disputed question, some investigators claiming that its whole and only influence proceeds from a direct stimulation of the heart-muscle, while others consider its action to be upon the nervous system. In a sense both are true. There are

direct muscle stimulation and vagus inhibition. In some instances the heart is rapid by a preponderance of the one, in other cases, slowed by the greater action of the second. Blood-pressure increase is due to both central and peripheral causes, the heart-muscle being stimulated and the arterioles contracted.

Nervous System.—The drug is a decided cerebral excitant, stimulating the mental function, occasioning wakefulness, and under large doses producing hallucinations and delirium.

Caffeine renders the reasoning and imaginative powers more acute, enabling the person to perform increased and prolonged mental work. Rarely, the ability to take in ideas is increased, and there is a heightened power of association of ideas.

On the medulla caffeine is a stimulant. The spinal cord reflexes are also rendered more responsive. Muscular endurance is increased by moderate amounts; large doses, on the other hand, occasion muscular trembling and weakness. In moderate amounts coffee possesses some aphrodisiac action. Excessive doses lessen the activity of the spinal reflex centers.

Respiration is both quickened and strengthened. It is one of the most reliable and least toxic of the direct respiratory stimulants.

Kidneys.—Caffeine and all of the xanthines are marked diuretics. They cause an increase in the fluids, both by reason of increased filtering by heightened tension in the glomeruli, and they are also direct kidney epithelium stimulants. At times caffeine diminishes urinary secretion by a strong vasomotor action. Theobromine (monomethyl xanthine) is a better diuretic. Both the liquid and solid parts are increased.

Temperature.—Under large doses of the drug the temperature is slightly elevated, the result of combined increase of heat-production and heat-dissipation. Toxic doses first raise, and then depress, temperature.

Eye.—Strong solutions of caffeine applied to the cornea act as a mild mydriatic and anesthetic. Hutchinson records a case of amblyopia produced by the drug.

Absorption and Elimination.—Caffeine is freely absorbed, and is readily broken down in the body—first, into lower methylated xanthines and then into urea.

Ordinarily caffeine lessens tissue-waste; the elimination of urea, however, is not uniform, being in some cases increased and in others diminished.

Untoward Action.—Caffeine occasionally causes marked cerebral congestion, insomnia, and embarrassment of respiration, while the untoward effects of an immoderate use of coffee are described by Guilliot (*Nat. Disp.*, p. 363) as follows:

"The skin is pale or dusky, the expression is dull, and the features have the look of premature old age, and sometimes are slightly swollen. The flesh wastes, the eyes have a glassy look, the pupils are dilated, the lips and tongue are tremulous; the appetite is lost; there is insomnia or else disturbed sleep; dyspep-

sia accompanies constipation or diarrhea; neuralgia affects the stomach and other parts; headache and vertigo are common, and spasms or general convulsions may occur." According to the same writer, "habitual excess of coffee induces in men sexual apathy and impotence, and in women leucorrhea. Sometimes it produces *pruritus ani aut vulvæ*."

Poisoning.—A case has been reported by Liell where 18 grains (1.16 Gm.) of citrated caffeine taken by a women were in an hour and a half accompanied by the following symptoms:

"Delirium, semi-consciousness, absence of headache, pulse 55 and irregular, cold extremities and general clammy perspiration, normal temperature (?), anesthesia, slight paresis of hands, feet, and tongue, and a reeling gait. Convulsions followed of a tetanoid character; the pupils were normal, the vision dim; some vomiting took place; there was abdominal colic, but no opening of the bowels; and urination was frequent and copious."

Treatment of Poisoning.—This should include the use of emetics and eliminants, together with diffusible stimulants and the application of external heat.

Therapeutics.—*Externally and Locally.*—Burning COFFEE in a room deodorizes the air.

Internally.—The chief value of CAFFEINE is as a diuretic and cardiac stimulant, being peculiarly useful in cases of *senile cardiopathies associated with nephritis*, in which, from degeneration of the heart-muscle, digitalis is not well tolerated.

In some instances the primary effect of caffeine is to increase the pulse-rate; usually, however, if the remedy be adapted to the case, there is a secondary slowing of the heart's action. The drug is considered by some physicians to be superior to digitalis as a cardiac stimulant in valvular disease accompanied by *fatty heart.* It is an efficient remedy to counteract the *cardiac depression in low fevers*, and is a comparatively safe drug in *myocarditis*.

It is a remarkably efficacious remedy in *cardiac* and *renal dropsy* and to remove *pleuritic effusion*, etc.

Caffeine cannot displace digitalis as a heart tonic, but as diuretics the xanthin derivatives, caffeine and theobromine, are excellent. Theobromine is the better diuretic of the two. They both act as stimulants to the kidney epithelium, and contrasted with the saline diuretics, which increase the elimination of inorganic salts, the xanthine derivatives aid in the elimination of nitrogenous substances, notably urea and uric acid.

Its action upon the digestive system renders caffeine of great value as a stomachic tonic. *Migraine*, due either to gastric catarrh or nervousness, frequently yields to this drug.

Its value in the treatment of *headaches* may be enhanced by administering it together with antipyrine or sodium bromide.

Choleraic diarrhea, the result of nervous depression, is often markedly benefited by CITRATED CAFFEINE. It has also been used with some success in the *diarrhea of phthisis*.

SODIOBENZOATE OF CAFFEINE in doses of 5 to 10 grains (0.32–0.64 Gm.) is considered by Misrachi to be superior to ergot in *postpartum hemorrhage*. CAFFEINE possesses a considerable reputation as a remedy for *asthma*. Caffeine is invaluable in the treatment of shock, and in all poisoning associated with low blood-pressures and respiratory depression. It is a valuable stimulant in *acute adynamia*, particularly in *typhoid fever*.

It is a matter of frequent observation that strong COFFEE certainly modifies the effects of *alcoholic intoxication*. *Hiccough* is often relieved by coffee.

CAFFEINE or strong COFFEE has unquestionably proved valuable in the reduction of *strangulated hernias* after taxis has failed.

The medical uses of CAFFEINE would be incomplete without mention of its extreme value in *opium-poisoning*. Here a salt of caffeine may be used hypodermically or a strong infusion of COFFEE given by the mouth or rectum.

Contraindications.—Ordinarily, caffeine is contraindicated in acute inflammations, particularly of the kidney.

Administration.—The alkaloid may be given by the stomach, but when hypodermic medication is desired caffeine is unavailable, a fresh salt for hypodermic use being properly employed, made by combining caffeine with salicylic acid, cinnamic acid, or sodium benzoate. The latter salt—sodio-benzoate of caffeine—is probably the most eligible and contains 45 per cent. of caffeine.

The citrated caffeine should be given in pills, capsules, or tablets; the effervescent citrate, in water.

A valerianate of caffeine is prepared which has been employed with success, it is asserted, in *hysterical vomiting* and *whooping cough* in doses of from ½ to 2 grains (0.03–0.12 Gm.).

Strong coffee serves as a most excellent substitute for the alkaloid, and may be given by the mouth or as an enema.

Meat Extracts.—These contain high percentages of xanthin or purin bases, creatin, creatinin, etc., in addition to mineral salts. It was at first assumed, by the manufacturer at least, that these beef extracts represented the concentrated essence of beef, and as such they were valuable food-products. Such, however, is not the case, and this class of bodies is best classed with the xanthin stimulants. Their action is on the heart and blood-vessels and they are active diuretics. They are not foods in any sense.

DRUGS ACTING CHIEFLY TO INHIBIT CARDIAC ACTIVITY AND TO CAUSE VASODILATATION.

Aconītum—Aconīti—Aconite. *U. S. P.*

Origin.—The dried tuberous root of *Aconitum Napellus* L., collected in autumn, and yielding when assayed not less than 0.5 per cent. of aconitine, a plant about 40 inches (1 M.) high, met with throughout the greater portion of Asia and Europe, mostly in mountainous regions.

Other species of *Aconitum* contain *aconitine*. Thus the Himalayan plant *Aconitum*

ferox contains it, and a closely related alkaloid, *pseucaconitine*, while the *Aconitum Japonicum* contains *japaconitine*. Aconitine is chemically an acetyl benaconine.

Description and Properties.—From $\frac{2}{5}$ to $\frac{4}{5}$ inch (10–20 Mm.) thick at the crown, and from 2 to 3 inches (50–75 Mm.) long, with scars or fragments of radicals; dark brown externally, whitish internally; with a rather thick bark, the central axis about seven-rayed; without odor, taste at first sweetish, soon becoming acrid, and producing a sensation of tingling and numbness lasting for some time. It contains an acrid alkaloid, *aconitine*.

Dose.—$\frac{1}{2}$–2 grains (0.03–0.12 Gm.) [1 grain (0.65 Gm.) U. S. P.]

Official Preparations.

Flūidextrăctum Aconīti—Flūidextrăcti Aconīti—Fluidextract of Aconite.—*Dose*, $\frac{1}{10}$–2 minims (0.006–0.12 Cc.) [1 minim (0.05 Cc.), U. S. P.].

Tinctūra Aconīti—Tinctūræ Aconīti—Tincture of Aconite (10 per cent.).—*Dose*, 1–15 minims (0.015–1 Cc.) [10 minims (0.6 Cc.), U. S. P.].

Aconitīna—Aconitīnæ—Aconitine. *U. S. P.*

Definition.—An alkaloid obtained from Aconite.

Description and Properties.—Colorless or white rhombic tables or prisms, odorless, permanent in the air, and producing in extremely diluted solutions a characteristic tingling sensation when brought in contact with the mucous membrane of the tongue or lips. The alkaloid itself should never be tasted, and its solution only when largely diluted, and then with the utmost caution. The chemical structure of aconitine is analogous to that of atropine and cocaine.

Very slightly soluble in water (1 : 3200), much more so in alcohol (1 : 22).

Aconitine was formerly in the U. S. Pharmacopœia, but was dropped in 1880, owing to the variable composition of the article then on the market. At present there are on the market, in addition to the crystalline aconitine, an amorphous aconitine and an eclectic "aconitin." The greatest caution should be observed not to confuse these preparations, as they differ considerably in composition.

Aconitine is the most powerful drug in the Pharmacopœia; death is reported to have resulted from 0.5 milligramme ($\frac{1}{128}$ grain).

Dose.—Average dose: 0.00015 Gm. = 0.15 milligramme ($\frac{1}{400}$ grain) (U. S. P.).

Unofficial Preparation.

Oleātum Aconitīnæ—Oleāti Aconitīnæ—Oleate of Aconite.—A 2 per cent. solution of Aconitine in Oleic Acid. For external use. (N. F.)

Antagonists and Incompatibles.—Digitalis and other cardiac stimulants, including atropine and ether, antagonize the action of aconite.

Synergists.—All members of the group and cold enhance the action of the drug.

Physiological Action.—*Externally and Locally.*—Applied to mucous membranes or to the skin for any length of time, aconite first stimulates and then depresses the ends of the sensory nerves, producing respectively tingling, numbness, and local anesthesia.

Internally.—Digestive System.—Except when given in very dilute solutions, aconite produces tingling and numbness of the lips and mouth, with increased secretion from the salivary glands. Large doses cause great irritation, together with a sense of constriction in the fauces. Anesthesia to taste is also produced.

Under normal conditions of the stomach aconite may act upon that organ as a sedative, augmenting its secretions. Large doses may occasion pain, nausea, and vomiting.

Circulatory System.—Aconite causes a marked slowing of the heart's action, due to stimulation of the vagus center in the medulla. Following the slowing of the heart, due to vagus action, aconite has a direct action on the heart-muscle, increasing its irritability, causing it to become very rapid and weak, eventually occasioning delirium cordis through overstimulation. Death may occur from cardiac paralysis, the heart being arrested in diastole. The arterioles are at first contracted, owing to stimulation of the vasomotor center in the medulla; but a marked diminution in the force of the ventricular systole brings about a great decrease of blood-pressure. In poisoning there are vessel dilatation and great loss of blood-pressure.

Nervous System.—Moderate or even large doses have little or no effect on the cerebral centers. The main action of aconite in the nervous system is on the medulla. Here there is stimulation followed by depression. Excessive doses of aconite cause a slight stimulation of the sensory nerve-endings, finally followed by depression, the muscles passing into a state of paralysis, probably occasioned by direct action upon the muscle-tissue.

Respiratory System.—The respiration is slowed by moderate doses; under large doses it is rendered both shallow and slow. The breathing is retarded, because the peripheral endings of the vagi distributed to the lungs are depressed. Under large doses there is depression of the respiratory center, paralysis of which is occasioned by lethal amounts.

Temperature.—Aconite is alleged to be a decided antipyretic, the reduction of temperature being due to various causes: (1) The slowing of the circulation, diminishing the metabolism; (2) the peripheral action of aconite, causing dilatation of the cutaneous blood-vessels; (3) the depressing action of the drug upon all muscle-tissue.

Eye.—Toxic amounts of the drug have produced mydriasis, misty vision, and diplopia.

Absorption and Elimination.—Aconite is rapidly absorbed, but its channels of elimination are not definitely known, although it is probably excreted by the kidneys, and to some extent by the skin, the drug acting as a mild diaphoretic.

Untoward Action.—Besides the symptoms described under "Poisoning," there have been observed pustular and erythematous eruptions, vertigo, and dimness of vision.

Poisoning.—The first effect of toxic doses is to cause marked tingling of the tongue and lips, which sensation soon extends to the fingers and may even affect the entire cutaneous surface. There is extreme muscular weakness, particularly noticeable in the lower extremities. Salivation, excessive cold clammy perspiration, nausea, vomiting, diarrhea, and pain in the stomach occur. The pulse, at first slow and weak (down to 40), soon becomes rapid and almost imperceptible. The respirations are quite feeble and shallow, being at times reduced to 10–12 to the minute, and there may be marked dyspnea.

The countenance is anxious and the skin pallid, cold, and covered with sweat, with great reduction of temperature. These symptoms are accompanied by dimness of vision, the pupils usually being widely dilated. Rarely there are present epileptiform convulsions.

Death may be postponed for some time, or it may rapidly follow a lethal dose. The minimum lethal dose of aconitine for adults is $\frac{1}{20}$ grain (0.003 Gm.).

Treatment of Poisoning.—The patient should be placed in a horizontal position, better with the feet raised slighly. The stomach should be thoroughly evacuated; bodily heat should be maintained by external warmth; diffusible stimulants, such as ether, alcohol, and spirits of ammonia should be given. Caffeine is useful, but artificial respiration is of the greatest service.

Therapeutics.—*Externally and Locally.*—Whether locally applied or given internally ACONITE is an excellent remedy in *neuralgias*, particularly in *tic douloureux.* The TINCTURE, ACONITE LINIMENT, or an OINTMENT OF ACONITINE may be applied to the course of the affected nerve. The TINCTURE OF ACONITE frequently proves beneficial in *herpes zoster*, *chilblain*, *pruritus*, etc., and its extended application has even been recommended to allay the pain of *chronic rheumatism.*

Internally.—ACONITE is an exceedingly efficacious remedy in many febrile diseases, particularly the *sthenic fevers* of children and those fevers resulting from inflammation, such as *tonsillitis*, *laryngitis*, *pharyngitis*, *quinsy*, etc. The drug seems to exert a peculiarly beneficial influence on mucous membranes, all acute inflammatory conditions of the throat, bronchial tubes, or intestinal canal —characterized by fever, a small, wiry pulse, and rapid cardiac action—being greatly improved by the remedy. Digitalin may be advantageously added to aconitine in these cases to steady the heart, veratrine to increase elimination, and strychnine arsenate to increase vitality.

As previously indicated, aconite is one of the most efficient sedatives in the *irritative fevers of children.* It is equally valuable in the *first stage of pneumonia* and in *pleurisy*, and is an invaluable adjunct to opium in the treatment of *peritonitis.*

Pericarditis is often favorably influenced by this drug, while it is also of great service in allaying *nervous palpitation* of the heart or that due to *excessive cardiac hypertrophy.*

The injection into the rectum of 8 or 10 minims (0.5–0.6 Cc.) of the TINCTURE OF ACONITE, while perhaps producing a slight prolapsus of the rectum, quickly affects an *irritable stricture of the urethra*, so that a catheter may be passed with little difficulty, although the operation may have been previously found impossible.

Probably there is no better combination to "break up a *cold*" than aconite and Dover's powder, the TINCTURE OF ACONITE, given at frequent intervals for a few hours, being followed, preferably at bedtime, with 8 or 10 grains (0.5–0.6 Gm.) of Dover's powder.

In sudden congestions from exposure to cold and wet, with consequent chills, headache, stoppage of menstruation, etc., the prompt use of aconite will generally restore the circulatory equilibrium and bring back the flow, averting a serious illness.

ACONITE has been favorably recommended in the acute stages of *cerebrospinal meningitis* and as a cardiac sedative in *aneurism.*

Contraindications.—Aconite is always contraindicated in subacute or chronic conditions, or when the heart's action is weak. It is also intolerable in catarrhal conditions of the stomach.

Administration.—A good, reliable tincture is the best preparation for internal use. Moreover, better results are obtained by giving the drug in fraction of minim doses—from $\frac{1}{10}$ to $\frac{1}{2}$ minim (0.006–0.03 Cc.) in a teaspoonful of water every fifteen minutes—than by larger dosage. The most desirable influence of the drug appears to be realized by this method.

Verātrum—Verātri—Veratrum. *U. S. P.*

(AMERICAN HELLEBORE.)

Origin.—The dried rhizome and roots of *Veratrum viride* Solander, a plant growing in swampy places and damp thickets in Canada, and in the United States as far south as Georgia. The plant closely resembles V. album of Europe, and is also allied to a species found in Eastern Siberia.

Description and Properties.—Rhizome upright, obconical, simple or divided, from 2 to 3 inches (50–75 Mm.) long; externally blackish-gray, internally grayish-white, showing numerous short, irregular wood-bundles. Many shrivelled, light yellowish-brown roots issue from all parts of the rhizome.

The drug is inodorous, but strongly sternutatory when powdered, the taste bitterish and very acrid.

Veratrum viride contains the following alkaloids: *veratrinejervine, pseudojervine, rubijervine,* and *cevadine.* The veratrine is in small amounts only. The closely related *Asagræa officinalis* or Sabadilla contains veratrine in larger amounts; it also contains a related alkaloid protoveratrine.

Dose.—$\frac{1}{6}$–5 grains (0.01–0.3 Gm.) [2 grains (0.125 Gm.), U. S. P.].

Official Preparations.

Flūidextrăctum Verātri—Flūidextrăctum Verātri—Fluidextract of Veratrum.—*Dose,* $\frac{1}{4}$–5 minims (0.01–0.3 Cc.) [1$\frac{1}{2}$ minims (0.1 Cc.), U. S. P.].

Tinctūra Verātri—Tinctūræ Verātri—Tincture of Veratrum (10 per cent.). —*Dose,* 1–15 minims (0.06–1 Cc.) [15 minims (1 Cc.), U. S. P.].

Allied Drugs.

Verātrum Ălbum—Verātri Ălbi—White or European Hellebore.

Sebadĭlla—Sebadĭllæ—Cevadilla.

The seeds of this plant yield the following official alkaloid, known as Veratrine:

Veratrīna—Veratrīnæ—Veratrine. *U. S. P.*

Definition.—A mixture of alkaloids obtained from the seed of Asagræa officinalis (Charts and Schlech.) Lundl.

Description and Properties.—A white or grayish-white, amorphous or semicrystalline powder; odorless, but causing intense irritation and sneezing whenever even a minute quantity reaches the mucous membrane; of an acrid taste, and leaving a sensation of tingling and numbness on the tongue; permanent in the air; very slightly soluble in hot or cold water, soluble in 3 parts of alcohol.

Dose.—$\frac{1}{40}$–$\frac{1}{4}$ grain (0.0016–0.016 Gm.) [$\frac{1}{30}$ grain (0.002 Gm.), U. S. P.].

Official Preparations.

Oleātum Veratrīnæ—Oleāti Veratrīnæ—Oleate of Veratrine (2 per cent.). For external use.

Unguĕntum Veratrīnæ—Unguĕnti Veratrīnæ—Veratrine Ointment (4 per cent.). For external use.

Antagonists, Incompatibles, and **Synergists** are the same as for Aconite.

Physiological Action.—*Externally and Locally.*—Veratrum is more of an irritant than aconite, exciting some inflammation of the skin when applied locally, and when in contact with the nasal mucous membrane producing violent sneezing.

Internally.—Its effects are in every respect analogous to those of aconite, with the following exceptions, in the several systems:

Digestive System.—Veratrum is more apt to occasion nausea and vomiting.

Circulatory System.—The drug is a more powerful depressant to the circulation, small doses, while not materially affecting the pulse-rate, greatly reducing its force, large doses rendering the pulse very weak, almost indistinguishable, and very rapid.

Nervous System.—It causes, as does aconite, analgesia, and in large doses also paralyzes the muscles in an unknown manner. Under moderate doses there is extreme muscular weakness. Veratrine causes this loss of muscular power, while pseudoveratrine does not.

Respiratory System.—Veratrum depresses the respiration less than aconite.

Absorption and Elimination.—The drug is absorbed with great facility, and is eliminated chiefly by the bowels. It possesses much feebler diuretic and diaphoretic properties than aconite.

Temperature.—In medicinal doses it is not so powerful an antipyretic as aconite.

Untoward Action.—Veratrum occasionally produces an erythematous or pustular eruption.

Poisoning.—Except that the drug may cause less anesthesia, the symptoms of poisoning are almost identical with those occasioned by aconite.

Treatment of Poisoning.—The same as prescribed for aconite.

Therapeutics.—*Externally and Locally.*—VERATRUM VIRIDE is seldom, if ever, used locally. VERATRINE, though in rare cases given internally, is well-nigh restricted to external or local application.

The OLEATE OR OINTMENT OF VERATRINE when applied over the affected nerve is exceedingly efficacious in *neuralgia*, particularly in *tic douloureux* and *orbital neuralgia*. In the latter affection great care should be taken in administration, lest some portion of the drug enter the eye, in which case violent and persistent conjunctivitis would ensue.

Internally.—VERATRUM VIRIDE may be employed for the same conditions for which aconite is recommended, although it is doubt-

ful whether it possesses any advantages over the latter drug; indeed, by many competent physicians it is considered inferior to, and more dangerous than, aconite. Moreover, the nausea and vomiting which in many patients are likely to follow the ingestion of this drug render its use objectionable. A large number of physicians claim to have found it of value in the treatment of *puerperal eclampsia*. Here it should be given in doses sufficient to cause nausea or even vomiting.

Contraindications.—The same as for aconite.

Administration.—The tincture of veratrum viride only should be given, beginning with small doses, as recommended for aconite, and cautiously increasing the amount. Veratrine may be applied in the form of an ointment, oleate, or in solution together with alcohol and glycerin.

Phytolăcca—Phytolăccæ—Phytolacca. *U. S. P.*

(POKE-ROOT.)

Definition.—The dried root of *Phytolacca decandra* L.

Description and Properties.—Large, conical, branched, and fleshy; mostly in transverse or longitudinal slices, wrinkled, grayish, hard; fracture fibrous, the wood-bundles in several distinct concentric circles; inodorous; taste sweetish and acrid. It contains resin, gum, fixed oil, tannin, starch, sugar, and a glycosid. Phytolaccotoxin is an alkaloid related to picrotoxin, which is found in a Japanese speciesof *Phytolacca.*

Dose.—5–30 grains (0.3–2.0 Gm.).

Official Preparation.

Flūidextrăctum Phytolăcca—Flūidextrăcti Phytolăccæ—Fluidextract of Phytolacca.—*Dose*, 5–30 minims (0.3–2.0 Cc.) [1½–15 minims (0.1–1 Cc.) as alterative or emetic respectively. U. S. P.]

Physiological Action.—*Externally and Locally.*—The powdered root is extremely irritating to mucous membranes, in certain subjects occasioning an erythematous eruption and excoriations.

Internally.—Digestive System.—Phytolacca possesses emetocathartic properties. It occasions much nausea, with great depression, persisting for some time before vomiting occurs. The drug augments the secretion of bile and acts as a laxative.

Circulatory System.—Like aconite, its reduces the force and frequency of the heart's action and lowers arterial tension.

Nervous System.—Poke-root is a powerful motor depressant, acting as a direct paralyzant to the spinal cord and medulla, although the muscles and motor nerves are unaffected.

Respiratory System.—Phytolacca is a respiratory depressant, rendering the breathing slow and shallow. Toxic doses produce death by paralysis of the respiratory center, preceded by tetanic convulsions.

Absorption and Elimination.—The drug is readily absorbed, and is eliminated chiefly by the kidneys.

Temperature.—Medicinal doses have no effect on temperature.

Poisoning.—The symptoms of poisoning are quite similar to those

produced by veratrum, though the nausea and vomiting are postponed longer after the ingestion of phytolacca.

Treatment of Poisoning.—The same as recommended under Aconite and Veratrum.

Therapeutics.—*Externally and Locally.*—Preparations of phytolacca have been successfully used to *allay inflammation*, as in cases of *follicular pharyngitis*, *tonsillitis*, *mastitis*, *ulcers*, *buboes*, *burns*, *abscesses*. The drug is also useful in *chronic eczema*, *sycosis*, *favus*, etc. The FLUIDEXTRACT may be applied, or the powdered root incorporated in ointment either signally or associated with other medicinal agents.

Internally.—The drug has proved of doubtful service in *chronic rheumatism*, its alterative properties rendering it also of some service in the treatment of *scrofula*, *syphilis*, and *chronic diseases of the skin*.

It has been recommended in *obesity*, possessing undoubted efficacy in this respect. It is claimed that the proprietary preparation known as "Anti-fat" is a resinoid preparation of the berries.

Contraindications.—The same as for veratrum viride.

Administration.—No special directions are necessary. The powder, tincture, or fluidextract may be given internally; for topical use an ointment may be prepared.

Pulsatilla—Pulsatillæ—Pulsatilla. (*Non-official.*)

Origin.—The herb of *Anemone Pulsatilla* and *Anemone pratensis* L., collected soon after flowering.

Description and Properties.—Leaves radical, petiolate, silky-villous, twice or thrice deeply three-parted or pinnately cleft, with linear, acute lobes, appearing after the large purple flowers; inodorous, very acrid. It contains a peculiar, acrid, crystallizable principle known as *anemonin*. Other constituents not as yet isolated may also be present.

Dose.—1–5 grains (0.06–0.3 Gm.).

Physiological Action.—*Externally and Locally.*—Pulsatilla is a decided irritant to the skin, the bruised plant when rubbed upon it even producing vesication. In the mouth it produces a sensation of burning, succeeded by numbness.

Internally.—The action of the drug is similar to that of aconite, though pulsatilla possesses greater emetic properties.

Therapeutics.—The drug may be employed for the same purposes as aconite, though as a cardiac sedative it is less efficient. It has been recommended as a useful emmenagogue.

Ărnica—Ărnicæ—Arnica. *U. S. P.*

Origin.—The dried flower-heads of *Arnica montana* L., a plant indigenous in the mountainous regions of Europe and Northern Asia, and also found in the northwestern part of America.

Description and Properties.—Heads about 1 to 2 inches (25–50 Mm.) in diameter, depressed-roundish, consisting of a scaly involucre in two rows, and a small, nearly flat, hairy receptacle, bearing about sixteen yellow, strap-shaped, ten-nerved ray-florets and numerous yellow, five-toothed, tubular disk-florets, with slender, spindle-

shaped akenes crowned by a hairy pappus. Odor feeble and aromatic; taste bitter and acrid.

Arnica flowers contain a glycosid (?), *arnicin*, a *volatile oil*, caproic and caprylic acids, resins, tannin, etc.

Dose.—5–30 grains (0.3–2.0 Gm.) [15 grains (1 Gm.), U. S. P.].

Official Preparation.

Tinctūra Ārnicæ—Tinctūræ Ārnicæ—Tincture of Arnica (20 per cent.).—

The *root* of *Arnica montana* and all its preparations official in the Pharmacopœia of 1890, have been dropped from the Pharmacopœia of 1900.

Physiological Action.—*Externally and Locally.*—The local action of both the root and flowers is irritant, that of the latter being the more powerful. Occasionally tincture of arnica flowers produces marked inflammation of the skin, resembling erysipelas.

Internally.—The internal effects of arnica are as yet imperfectly understood, it being difficult to assign the drug to its proper group.

Digestive System.—Small doses slightly stimulate the digestive apparatus. Large amounts produce nausea, vomiting, and diarrhea of a choleraic character.

Circulatory System.—Small doses stimulate the heart and increase arterial pressure; full or large doses retard the pulse and depress the circulation.

Nervous System.—Large amounts cause headache, with great depression of the nerve-centers. Toxic amounts occasion motor and sensory paralysis, coma, at times convulsions, collapse, and death.

Respiratory System.—The respiration is slowed, although under small doses there may be temporary acceleration.

Absorption and Elimination.—The active principle of arnica diffuses readily into the blood, the drug being eliminated chiefly by the kidneys, though the skin shares in the excretory process.

Temperature.—Large doses cause a reduction of temperature.

Untoward Action.—The topical application of arnica may cause in susceptible persons violent cutaneous inflammation and the production of pustules, or even distinct bullæ, attended with marked constitutional symptoms. When taken internally the drug occasions a sensation of burning in the mouth and throat, violent pain in the stomach, tenesmus, and choleraic diarrhea, intense headache, and dizziness.

Poisoning.—In addition to the above-named symptoms there are great cardiac depression, decided muscular weakness, slow and shallow respiration, paralysis of the nervous system, and death resulting from collapse.

Treatment of Poisoning.—The treatment should be much the same as that prescribed under Aconite. Atropine is probably the best physiological antidote.

Therapeutics.—*Externally and Locally.*—ARNICA enjoys a wide reputation as a remedy for the relief of *bruises*, *sprains*, and *external*

inflammations generally. It is highly probable that its efficiency is due in part to a slight counterirritant effect, and to the alcohol contained in the mixtures. It has been recommended also as a topical application in *myalgic rheumatism.* The local application of the TINCTURE causes the rapid disappearance of *ecchymoses.* Equal parts of TINCTURE OF ARNICA and glycerin, diluted with water, have been recommended as a stimulant in *inflammation of the mucous membrane of the mouth.*

Internally ARNICA is not a very popular remedy.

Contraindications.—*Externally* when there exists any acute skin disease; *internally* in cases of inflammation of the gastro-intestinal tract, fatty or valvular disease of the heart, and in all asthmatic conditions.

Administration.—The tincture of arnica is the form generally preferred for external and internal use. In applying any preparation externally the susceptibility to the irritating properties of the drug peculiar to certain persons should be remembered.

VASODILATORS.

One set of the circulatory drugs has the primary property of dilating the blood-vessels and of reducing the blood-pressure. This action is in large part due to a depressing action they exert on unstriped muscular fiber, particularly on the walls of the blood-vessels. These drugs are practically the exact opposites in their action to that of adrenalin and ergot. They are all nitrites, in which the NO ion is the active part of the molecule. The most important of these are amyl nitrite, nitroglycerin, sodium and potassium nitrite, erythrol tetranitrite, and mannitol hexanitrite.

In addition to their action on the blood-vessels the nitrites affect the blood. They cause the formation of methemoglobin and thus limit oxidation in the tissues.

Ămylis Nītris—Ămylis Nitrītis—Amyl Nitrite. *U. S. P.*

Origin.—A liquid containing about 80 per cent. of amyl (principally iso-amyl) nitrite. Obtained by the action of nitric acid upon amylic alcohol.

Description and Properties.—A clear yellow or pale-yellow liquid, of a peculiar, ethereal, fruity odor and a pungent, aromatic taste. Almost insoluble in water; miscible in all proportions with alcohol or ether. In alcoholic solution it gradually decomposes, with formation of ethyl nitrite and amylic alcohol. It should be kept in small, dark-colored, glass-stoppered bottles, in a cool and dark place, remote from lights and fire.

Dose.—½–1 minim (0.03–0.06 Cc.) internally; for inhalation 1–5 minims (0.06–0.3 Cc.) [3 minims (0.2 Cc.), U. S. P.].

Physiological Action.—*Externally and Locally.*—Its action is that of a mild irritant when applied to the skin.

Internally.—The following actions apply to ingestion or inhalation of the drug.

Circulatory System.—Almost immediately after inhalation of amyl nitrite there is a marked flushing of the skin, first perceptible

in the face, doubtless occasioned by dilatation of the capillaries. The heart's action is increased and somewhat weakened, and the pulse is soft and compressible. The blood-pressure falls very markedly, the condition being caused by a paralyzing action upon the muscle-fibers found in the walls of the small arterioles, causing marked dilatation. The same cause accounts for the change in the action of the heart, due to diminution of peripheral resistance. Amyl nitrite has little central action.

The inhalation of large amounts renders the heart very weak, toxic doses arresting that organ in diastole.

Nervous System.—Among the effects are cerebral oppression, flushing of the head and face, vertigo, headache, and confusion of ideas, with diminished reflex excitability, muscular weakness, and unsteadiness of gait, both the voluntary and involuntary muscles being relaxed. These actions are due to the depressing influence of the drug upon the motor areas of the brain and spinal cord.

Respiratory System.—Small doses quicken the respiration by lowering arterial pressure and possibly by moderate stimulation of the center, due to accumulation of carbon dioxide. Immoderate or toxic amounts render the breathing slow and labored from depression of the respiratory center and arrest of the oxygenating function of the blood.

Absorption and Elimination.—Amyl nitrite is rapidly absorbed, being eliminated chiefly by the kidneys, increasing the amount of urine, uric acid, and urea excreted. Sugar may frequently be detected in the urine, probably resulting from the action of the drug in dilating the hepatic vessels and increasing the circulation in the liver.

Blood.—Amyl nitrite, as all the nitrites, causes fixation methhemoglobin to take the place of oxyhemoglobin. Nitric-oxide-hemoglobin compounds are also formed. The blood becomes dark chocolate in color and asphyxiation may result, though rarely.

Temperature.—Bodily heat is reduced both in health and in fever, due to dilatation of the peripheral blood-vessels and a reduction of the oxygen-carrying power of the red blood-corpuscles.

Eye.—There is marked dilatation of the retinal vessels and hyperemia of the papilla, producing chromatopsia of the particolored variety and hallucinations of vision. These effects are usually transitory, and disappear with the elimination of the drug.

Uterus.—The uterine muscle is relaxed.

Untoward Action.—In addition to the symptoms described under "Poisoning," there have been noted gastric disturbance, nausea and vomiting, dryness of the mouth and trembling of the lips, irritation of the throat, defective vision, and subjective sensations of color, usually yellow vision.

Poisoning.—The toxic effects of amyl nitrite include an exceedingly rapid and weak heart, final retardation of the pulse, cyanosis of the face, slow and shallow respiration, cold extremities, subnormal temperature, great muscular weakness, abolished reflexes, vertigo, intense headache, and disordered vision. Death results

from cardiac or respiratory failure. 3.0 Gm. swallowed by mistake by a sixty-year-old man has produced alarming symptoms lasting several hours. The characteristic banana-like odor is valuable in diagnosis. Fusel oil is not distinguishable from it by odor alone.

Treatment of Poisoning.—Strychnine and digitalis are required to sustain the heart; ergotin or atropine may be administered subcutaneously, together with cold applications to the head, diffusible stimulants, and artificial respiration if necessary. Adrenalin is valuable.

Sōdii Nītris—Sōdii Nitrītis—Sodium Nitrite. *U. S. P.*

Origin.—It should contain not less than 90 per cent. of pure sodium nitrite. Obtained by heating sodium nitrate with lead, the oxygen from the nitrate being abstracted by the lead oxide formed.

Description and Properties.—White, opaque, fused masses, usually in the form of pencils, or colorless, transparent, hexagonal crystals; odorless, and of a mild, saline taste. When exposed to the air the salt deliquesces and is gradually oxidized to sodium nitrate. Soluble in about 1.5 parts of water; slightly soluble in alcohol. It should be kept in well-stoppered bottles.

Dose.—2–5 grains (0.12–0.3 Gm.).

Other Nitrites.

Erythrol tetranitrate and mannitol hexanitrite are organic nitrates that have similar action. This action is more prolonged, and is therefore to be recommended in chronic conditions. *Dose*, ½ grain (0.5 Gm.).

The comparison of the activity of these various nitrites is graphically represented in the following chart taken from Bradbury.

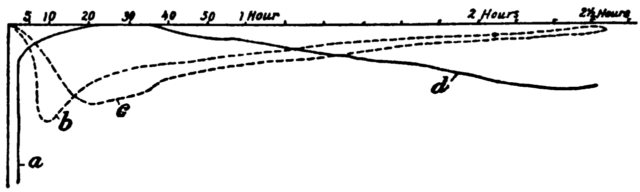


FIG. 1.—Diagram to illustrate the intensity and duration of the action of the members of the nitrite series. The extent of the fall of pressure is measured along the vertical, the duration along the horizontal, line: *a*, Amyl nitrite, ethyl nitrite, etc.; *b*, nitroglycerin; *c*, sodium nitrite; *d*, erythrol tetranitrate. The greatest reduction occurs in *a*, but it passes off for the most part in five minutes and entirely in twenty. Nitroglycerin acts more rapidly than the last two, and its effects continue almost as long as those of sodium nitrite. Erythrol tetranitrate only exerts its full effect after the action of the others has passed off (Bradbury).

Spīritus Glycerȳlis Nitrātis—Spīritus Glycerȳlis Nitrātis—Spirit of Glyceryl Trinitrate. *U. S. P.*

(SPIRIT OF NITROGLYCERIN.)

Definition.—An alcoholic solution containing 1 per cent. by weight of glyceryl trinitrate.

Origin.—Nitroglycerin is obtained by gradually adding dehydrated glycerin to a mixture of nitric and strong sulphuric acid, the nitroglycerin formed being washed with water and dilute soda solution to remove all acid.

Description and Properties.—Nitroglycerin occurs as a clear colorless liquid possessing the odor and taste of alcohol. It should be tasted and handled with great caution, since it is apt to produce violent headache, whether ingested or applied to the skin. It explodes with great force, and should be kept in a cool place, remote from lights or fire.

Dose.—1–3 minims (0.06–0.18 Cc.) of the spirit [1 minim (0.05 Cc.), U. S. P.].

The action of nitroglycerin is very similar to that of amyl nitrite, although it is less prompt, while more persistent. Nitroglycerin produces a frontal headache of much greater intensity than that caused by amyl nitrite. This is also true of sodium nitrite, though the headache it occasions is less severe than that resulting from nitroglycerin.

Nitroglycerin is preferable to amyl nitrite for internal administration.

Therapeutics.—*Externally and Locally.*—The nitrites are not used for external purposes.

Internally.—The property of AMYL NITRITE in suddenly lowering arterial pressure and dilating the arterioles renders it of inestimable value as a relief for the terrible precordial pain in *angina pectoris.*

Epileptic seizures may often be aborted by the instant inhalation of amyl nitrite upon the first indication of the *aura epileptica.* The drug has also been successfully employed for the relief of *asthma,* particularly the uremic form, as well as for *cardiac dyspnea* and *puerperal eclampsia.*

Like many other motor depressants, it has been used in the treatment of *tetanus* and *strychnine-poisoning.* It has proved an efficient preventive for the chill occurring in *virulent malarial fever,* and has served as a valuable antidote in *poisoning from chloroform.*

The drug is indicated in all conditions of high arterial tension, as in *chronic nephritis,* etc. It is also beneficial in *congestive dysmenorrhea.*

The SODIUM NITRITE is used for the same purposes as the amyl nitrite, though superior to it for internal administration, as in cases of abnormally high *arterial tension.*

NITROGLYCERIN is specially adapted for the treatment of *cardiopathies* occurring after middle life. It is useful in chronic nephritis with high arterial tension, and, associated with digitalis, is recommended in certain cases of pneumonia. The tendency to increase of peripheral resistance in the vessels after adult life is attained renders possible the favorable administration of doses of nitroglycerin intolerable in early life.

The drug is often of marked benefit in the *arrhythmia* of slightly enlarged and degenerated hearts with *arteriosclerosis.* It is also of considerable value in relieving the *pseudo-anginas* which are frequently a feature of vascular disease. It should be given in doses of $\frac{1}{200}$ to $\frac{1}{100}$ grain (0.00032–0.0006 Gm.) twice or four times daily.

It is fair to say, however, that recent experiments by H. P. Loomis show that high arterial pressure in man is not perceptibly affected by nitroglycerin nor its dilatation of the blood-vessels apparent. The usual dose of $\frac{1}{100}$ grain (0.0006 Gm.) is too small to produce any effect in pathologic conditions; $\frac{1}{40}$ grain (0.0015 Gm.) is a minimum dose. Even in large and repeated doses the author has never seen any ill effects. It is doubtful if the urine is increased in

quantity in chronic Bright's disease by this drug. In conditions due to arterial spasms, so called, such as angina pectoris, migraine, asthma, nitroglycerin may be of benefit in full doses, often repeated, but not in arterial sclerosis, where the arteries themselves are more or less changed.

Vaquez calls attention to the variability of the action of the drug. Its vasodilating action is totally absent in a large number of cases, even in comparatively large doses. In only exceptional cases can its action be regarded as identical with amyl nitrite.

The effects of nitroglycerin are so transitory that in order to maintain a more or less continuous effect on the circulation the drug should be given at frequent intervals. To affect arterial tension in chronic conditions erythrol tetranitrate is unquestionably the more efficacious drug.

Osler recommends the prolonged administration of nitroglycerin in *locomotor ataxia*, affirming that it lessens the frequency of the crises and relieves the neuralgic pains.

The drug is of use in *sciatica*, and frequently relieves obstinate *hiccough*. It has been recommended for the same diseases for which amyl nitrite is used.

PREPARATIONS OF AMMONIUM.

Āqua Ammōniæ Fŏrtior—Āquæ Ammōniæ Fortiōris —Stronger Ammonia Water. *U. S. P.*

Origin.—An aqueous solution of ammonia ($NH_3 = 16.93$), containing 28 per cent. by weight of gaseous ammonia.

Description and Properties.—A colorless, transparent liquid, having an excessively pungent odor and a very acrid and alkaline reaction. It should be kept in strong, glass-stoppered bottles.

Dose.—3–6 minims (0.18–0.3 Cc.).

Official Preparation.

Spīritus Ammōniæ—Spīritus Ammōniæ—Spirit of Ammonia.—*Origin.*—An alcoholic solution of ammonia, containing 10 per cent. by weight of the gas.

Description and Properties.—A colorless liquid, having a strong odor of ammonia and a specific gravity of about 0.808 at 25° C. (77° F.). It should be kept in glass-stoppered bottles, in a cool place.

Dose, 10–60 minims (0.6–3.7 Cc.) [15 minims (1 Cc.), U. S. P.].

Āqua Ammōniæ—Āquæ Ammōniæ—Ammonia Water. *U. S. P.*

Origin.—An aqueous solution of ammonia, containing 10 per cent. by weight of gaseous ammonia.

Description and Properties.—A colorless, transparent liquid, having a pungent odor, an acrid, alkaline taste, and a strongly alkaline reaction. It should be kept in glass-stoppered bottles, in a cool place.

Dose.—10–20 minims (0.6–1.2 Cc.) well diluted [15 minims (1 Cc.), U. S. P.]

Official Preparations.

Liniméntum Ammóniæ—Liniménti Ammóniæ—Ammonia Liniment (Ammonia Water, 350; Alcohol, 50; Cotton-seed Oil, 570; Oleic Acid, 30).—For external use.

Spíritus Ammóniæ Aromáticus—Spíritus Ammóniæ Aromátici. See *Ammonium Carbonate.*

Ammōnii Carbōnas—Ammōnii Carbonātis—Ammonium Carbonate. *U. S. P.*

Definition.—It should contain not less than 97 per cent. of a mixture of acid ammonium carbonate [$CO(OH)ONH_4$] and ammonium carbamate [$CO(NH_2)ONH_4$], and should yield not less than 31.58 per cent. of ammonia gas.

Origin.—Prepared by subjecting to sublimation and resublimation a mixture of ammonium sulphate or chloride and calcium carbonate.

Description and Properties.—White, hard, translucent, striated masses, having a strongly ammoniacal odor without empyreuma, and a sharp, saline taste. On exposure to air the salt loses both ammonia and carbonic acid, becoming opaque, and is finally converted into friable, porous lumps or a white powder. Slowly but completely soluble in about 5 parts of water; decomposed by hot water, with the elimination of carbonic acid and ammonia.

Ammonium carbonate should be kept in well-stoppered bottles, in a cool place.

Dose.—2–15 grains (0.12–1.0 Gm.) [4 grains (0.25 Gm.), U. S. P.].

Official Preparation.

Spíritus Ammóniæ Aromáticus—Spíritus Ammóniæ Aromátici—Aromatic Spirit of Ammonia (Ammonium Carbonate, 34; Ammonia Water, 90; Oil of Nutmeg, 1; Oil of Lemon, 10; Alcohol, 700; Oil of Lavender Flowers, 1; Water to make 1000).

Description and Properties.—A nearly colorless liquid when freshly prepared, but gradually acquiring a somewhat darker tint. It has a pungent, ammoniacal odor and taste. It should be kept in glass-stoppered bottles, in a cool place.

Dose.—½–2 fluidrams (1.8–7.3 Cc.) [30 minims (2 Cc.), U. S. P.].

Antagonists and Incompatibles.—The cardiac sedatives are antagonistic. The incompatibles are the vegetable and mineral acids, the earthy salts, lime water, and solutions of acidulous salts.

Synergists.—Cardiac and diffusible stimulants, antispasmodics, and capsicum internally. The local action of ammonium preparations is enhanced by cantharides and counterirritants.

Physiological Action.—*Externally and Locally.*—When solutions of ammonia are applied to the skin or mucous membranes they act as irritants, rubefacients, or vesicants according to the strength of the solution and the freedom or confinement of the vapor.

When inhaled the vapor occasions great irritation of the respiratory passages, together with a sense of suffocation and spasmodic closure of the glottis. There are also produced marked irritation of the conjunctivæ, lachrymation, and a watery secretion from the nose.

Internally.—*Digestive System.*—Small doses act like alkalies upon the gastro-intestinal tract, augmenting the flow of gastric juice when given before meals and neutralizing it when given after meals.

Excessive doses occasion violent and destructive inflammation of the mouth, esophagus, and stomach, possibly resulting in stricture of the esophagus and stenosis of the pyloric orifice.

Circulatory System.—These preparations, whether ingested or injected into the system, cause a temporary fall of arterial pressure, quickly followed by a decided increase and acceleration of the pulse, owing to nervous stimulation of the heart. Their precise action upon the blood is not known, though they certainly lessen the oxygen-carrying power of the red corpuscles and diminish the tendency to coagulation of the blood.

Nervous System.—Other than their action upon the sensory nerves when locally applied, these preparations affect the nervous system only in stimulating the motor centers of the spinal cord, excessive doses causing convulsions similar to strychnine.

Respiratory System.—They stimulate the respiratory center, greatly increasing the number of respirations.

Absorption and Elimination.—The preparations of ammonium are rapidly absorbed, being oxidized in the system and eliminated chiefly by the kidneys, increasing the acidity of the urine and augmenting its amount, as well as increasing the proportion of nitric acid, uric acid, and urea excreted. The continued use of ammonium preparations therefore promotes tissue-waste.

Temperature is unaffected by medicinal amounts.

Poisoning.—In toxic doses these preparations are powerful corrosive poisons, exciting violent inflammation of the gastro-intestinal tract, labored respiration, great cardiac depression, muscular weakness, and possibly convulsions.

Treatment of Poisoning.—Similar to that of poisoning by the corrosive alkalies—evacuation of the stomach, the internal administration of vinegar or other vegetable acids, followed by oil and demulcent drinks, opium being indicated for the relief of pain.

Therapeutics.—AQUA AMMONIÆ is a valuable ingredient of "hair tonics" in *premature alopecia.* The AMMONIA LINIMENT is a favorite remedy for *chilblains.*

The AROMATIC SPIRIT OF AMMONIA is of value in many diseases of the scalp, such as *pityriasis*, etc., and, when well diluted with water, has been recommended in *acute pharyngitis.* The AMMONIUM CARBONATE possesses an action similar to that of salicylic acid in its property of dissolving epidermic scales, rendering it of value in preparing the skin for the subsequent local treatment of *psoriasis.*

As a counterirritant AMMONIA WATER—or, preferably, the AMMONIUM LINIMENT—is efficient in *chronic rheumatism* and *joint-affections.*

AMMONIA WATER relieves the irritation caused by *bites of insects;* its vapor inhaled acts as a rapid restorative in cases of *fainting.*

Internally.—The ammonium preparations here mentioned are serviceable in lessening excessive *acidity of the stomach.* The AROMATIC SPIRIT OF AMMONIA is frequently beneficial in allaying

the distress of *nervous headache*, and is also an efficient remedy to counteract the *effects of an immoderate use of alcoholic stimulants*, in many cases having proved valuable in the treatment of *delirium tremens.*

The most important uses of these preparations are, perhaps, as powerful diffusible stimulants to the circulatory, respiratory, and spinal systems. They are of undoubted value in sudden *cardiac failure* arising from any cause, such as *poisoning from chloroform, noxious gases, hydrocyanic acid*, etc. Taken internally or by intravenous injection, they counteract the poisonous effects resulting from the *bites of venomous reptiles.*

The CARBONATE is an excellent stimulant to sustain the heart and respiration during the course of *pneumonia, eruptive* and *continued fevers*, etc. In all dynamic conditions of the heart this preparation should be given in small doses, frequently repeated. The carbonate is also a valuable stimulant expectorant in *chronic bronchitis* and *bronchopneumonia.*

The preparations of ammonia have been recommended in *threatened thrombosis.* The condition being established, however, it should be noted that the method of treatment by intravenous injection, advocated by some authorities, is at best a very dubious procedure.

Contraindications.—Acute gastritis and conditions of excessive acidity of the urine. Conditions of anemia and great emaciation would contraindicate the prolonged use of these preparations.

Administration.—The liquid preparations should always be well diluted, and the carbonate should invariably be given in solution. The fluidextract of glycyrrhiza disguises the taste very well.

Owing to the rapid elimination of these drugs, the dosage should be frequently repeated.

DRUGS ACTING LOCALLY ON MICRO-ORGANISMS (ANTISEPTICS).

MANY substances that act upon the protoplasm of living cells, either physically or chemically exert either a restrictive action on micro-organisms or are capable, according to the grade of concentration, of killing the micro-organisms themselves or their spores. These substances may be roughly classed as antiseptics. Germicides is a broader term. Bactericides are agents capable of killing bacteria or their spores; zoöcides are similar agents capable of killing minute animal parasites in the body of man or lower animals.

Great differences are found in the action of these substances whether the micro-organisms are spore-bearing or not. Thus, many bacteria are killed by a .1 per cent. solution of corrosive sublimate in a few minutes; while it requires an hour or even longer to kill the spores of other bacteria by this same bactericide. The spores of the anthrax bacillus can resist the action of 5 per cent. solutions of carbolic acid for several days. Analogous facts are known with reference to the animal parasites of malaria. Thus, quinine kills the free forms of the malarial parasites, while the encysted spore-bearing forms are killed with considerable difficulty.

General rules with reference to the germicidal action of various agents then are very difficult of application. Each organism is a law unto itself and should be so considered.

The germicides may be readily grouped into a few classes, and a chemical classification seems the most satisfactory. The groups that will be here considered are:

1. Metalloids: ozone, oxygen, hydrogen peroxide, other peroxides, and oxidizing agents.

These act largely as active oxidizers.

2. Metals and metallic salts. These act largely as protoplasm poisons, usually coagulating the albumin of the cell-body. Mercury, zinc, tin, copper, lead, aluminum, silver, etc.

3. Acids and alkalies.

4. Halogens and their combinations.

5. Bodies of the aromatic and fatty series, alcohols, aldehydes, anilines, phenols, volatile oils, etc.

I. OXIDIZING GERMICIDES.

Oxygen itself is not directly applicable as a germicide. In nature it undoubtedly plays an important part in general disinfection.

Ozone, O_3, as a gas has a feeble germicidal action. Wyssokowitsch has shown that in a percentage of 20–30 miligrams to the 100 cubic meters it has a restraining action on the development of many bacteria. Ozone, according to the researches of Ransome and Fullerton, has no particular action on the vitality of the tubercle bacillus.

Ozone developed in water by electrical means has some bactericidal action, but it is highly doubtful if it is a practical method for water disinfection, the results of Schrœder and Proskauer[1] notwithstanding.

Among the most useful of the oxidizing agents are the peroxides of hydrogen, and a number of recently introduced organic peroxides under the trade names of acetozone, alphazone, etc.

Āqua Hydrogēnii Diŏxidi—Āquæ Hydrogēnii Diŏxidi—Solution of Hydrogen Dioxide. *U. S. P.*

Origin.—A slightly acid, aqueous solution of hydrogen dioxide, which should contain, when freshly prepared, about 3 per cent. by weight of absolute hydrogen dioxide, corresponding to about 10 volumes of available oxygen.

Description and Properties.—A colorless liquid, without odor, slightly acidulous to the taste, and producing a peculiar sensation and a soapy froth in the mouth; liable to deteriorate with age or by exposure to heat or protracted agitation.

Dose.—1–4 fluidrams (3.7–15.0 Cc.), well diluted with water [1 fluidram (4 Cc.), U. S. P.].

Physiological Action.—*Externally and Locally.*—Applied to the skin it decomposes, but without much effect save in strong solution, when it irritates.

Applied to mucous membranes hydrogen peroxide is decomposed and oxygen is given off in large quantities. The oxygen given off is nascent and oxidizes surrounding substances very energetically. Applied to wounds or open surfaces the oxygen is given off in very large quantities.

In the stomach large quantities are also evolved, causing distention of the stomach in some instances. It is usually broken down completely before reaching the intestines.

Injected hypodermically oxygen is liberated, and if a blood-vessel is entered emboli of oxygen may form and it may thus cause death. Intravenous injection causes gas emboli and death.

The catalytic activity of the various organs after death varies considerably.

Therapeutics.—*Externally and Locally.*—Hydrogen dioxide is extensively employed to cleanse diseased surfaces, such as *ulcers*, *buboes*, *fistulous tracts*, etc. It has been highly recommended as an

[1] *Zeitschrift f. Hygiene*, vol. xli.

antiseptic in abdominal surgery. As an antiseptic wash in *empyema, cystitis, joint-cavities, venereal sores, puerperal septic endometritis*, etc., hydrogen dioxide is an exceedingly valuable agent.

Hydrogen dioxide appears to be an efficient injection in *gonorrhea*, and is much used as an antiseptic in many diseases of the *eye, ear, nose* and *throat*. It has been highly recommended as an application for *diphtheritic membrane*, although when frequently applied to the throat it causes an unpleasant sensation of dryness. It is highly valuable in tonsillitis. It is to be recommended for loosening up necrotic tissue wherever applicable.

Hydrogen dioxide serves a useful purpose in disinfecting drinking-water when suspected of pollution, 1 part sufficing for 1000 parts of water, in which amount the taste or other potable qualities of the water are in no way impaired.

Internally it has no important actions yet carefully studied. It may prove of some value in gastro-intestinal affections, and its use in the rectum, where the gas may be absorbed, is said to be of value by some clinicians.

Administration.—For external and local use the drug may be gargled, sprayed, or applied with a syringe or a swab, either in full strength or diluted with water. Whether for external or internal use, the solution should be freshly prepared; when given internally it should be taken from a porcelain or china, not a metal, cup or spoon.

ORGANIC PEROXIDES.

Organic peroxides have recently been manufactured. By replacing one of the hydrogens in H_2O_2, HOOH, by acetyl or benzoyl, $CH_3CO—O—OH$, $C_6H_5CO—O—OH$, acetyl peroxide and benzoyl peroxides are formed. Many others are possible, but as yet they are all comparatively unstable bodies. When two acetyl radicals are combined, $CH_3CO—O—O—COCH_3$, or acetyl and benzoyl, $CH_3CO—O—O—COC_6H_5$, a more stable series are formed. Acetozone and alphazone are of this general composition.

These organic peroxides have very powerful germicidal effects, and, moreover, as they split off their oxygen very slowly they have some important indications in gastro-intestinal affections that are not met by the more readily decomposable hydrogen peroxide.

They are valuable in gastric and intestinal fermentations and putrefactions, and have given some very striking results in limiting the distention in typhoid fever. That they can influence the disease process as a whole is hardly conceivable, by reason of the wide distribution of the typhoid bacillus, but these newer peracids have been useful in overcoming some of the distressing intestinal symptoms.

Whether they are to prove of service in increasing intracellular oxidative processes is a question of the future.

Both ACETOZONE and ALPHAZONE are used in solutions.

A PEROXIDE OF BISMUTH, BiO_2, has also been introduced of late

years. It is termed biogen commercially and it is claimed that it is valuable in increasing the oxidation functions of the body. It is used in doses of 5 to 10 grains.

CALCIUM PEROXIDE, gorite, is another of this general type. It is used as an intestinal disinfectant in 2- to 10-grain doses.

The persulphates of sodium and potassium, $Na_2S_2O_3$, PERSODINES, are commercially obtainable and are under investigation.

Potăssii Permănganas—Potăssii Permanganātis—Potassium Permanganate. *U. S. P.*

Definition.—It should contain not less than 99 per cent. of pure potassium permanganate.

Origin.—Obtained by heating together caustic potash, potassium chlorate, and manganese dioxide. The potassium manganate formed is converted into the permanganate by boiling it in water.

Description and Properties.—Slender, monoclinic prisms, of a dark-purple color, almost opaque by transmitted light, and of a blue, metallic luster by reflected light; odorless, with at first a sweet and afterward a disagreeable and astringent taste; permanent in the air; soluble in 16 parts of water. In contact with alcohol it is decomposed.

Potassium permanganate should be kept in glass-stoppered bottles, protected from light, and should not be brought in contact with organic or readily oxidizable substances.

Dose.—½-2 grains (0.03-0.12 Gm.), as a pill [1 grain (0.065 Gm.), U. S. P.].

Antagonists and Incompatibles.—Organic matter easily deoxidizes it, causing an explosion.

Synergists.—Other antiseptics enhance its germicidal action.

Physiological Action.—Potassium permanganate in contact with organic matter gives up a part of its oxygen. It loses its color thereby and is no longer active. Its action is very energetic but very superficial.

Therapeutics.—*Externally and Locally.*—In concentrated solutions or in substance it is a mild escharotic. Its readiness to part with oxygen renders it of great value as a deodorant, and in dilute solutions, 1 to 5 grains (0.06 to 0.32 Gm.) to 1 ounce (30 Cc.) of water, it is a useful application to *foul ulcers*, *cancer of the uterus*, *vagina*, etc. A solution of this drug is employed for various purposes as an antiseptic, germicide, and deodorant, in the treatment of *gonorrhea*, *leucorrhea*, *diphtheria*, *putrid sore throat*, *ozena*, *naso-pharyngeal catarrh*, *cancer of the tongue*, and *syphilitic ulcers*.

A weak solution of POTASSIUM PERMANGANATE is an efficient application in *bromidrosis*, and a 1 : 2000 or 1 : 5000 solution is recommended in *purulent ophthalmia*. Potassium permanganate should not be used as an antiseptic in the peritoneal cavity, on account of its irritating properties. It is employed extensively in surgical practice for washing the hands and utensils.

Internally.—Like iron, POTASSIUM PERMANGANATE has been employed in *anemia*, although far inferior to the former drug. Favorable reports are given regarding its value in *gastric fermentation* and *lithiasis*.

It has been recently advocated as an antidote to *morphine-poisoning*. Later investigations do not support the early claims. It has an oxidizing effect and undoubtedly destroys the free morphine substances that may remain in the stomach or be eliminated there.

Administration.—For internal use potassium permanganate should always be given in pill form, kaolin being used as an excipient, lest an explosion occur.

II. METALS AND THEIR SALTS.

The metals and their salts as a class are treated elsewhere in this volume, but a few words may be said concerning their action as germicides. They act as such largely because of the property of precipitating or coagulating protoplasm. Some few of these coagula are soluble in an excess of the metal or its salts. In this case the action as a germicide may be penetrating, whereas, for the most part, the action of the metallic germicides is superficial.

It has been pointed out that the germicidal power of any substance varies within fairly wide limits, particularly with regard to the spore-bearing and non-spore-bearing forms.

III. ACIDS, ALKALIES, SALTS, ETC.

Many of the acids and alkalies are active antiseptics. In weak solutions hindering the organisms in their growth, in stronger solutions killing them by withdrawing water, by coagulation of protoplasm, or by other physico-chemical interchange.

For the acids, those that dissociate readily are more actively germicide, thus tri-chlor-acetic acid, by reason of its ready power of dissociation, is almost as efficient a germicide as the much more powerful nitric acid. Acetic and formic acids are relatively weak because of their diminished powers of dissociation.

Sulphuric, nitric, acetic, boric, and arsenous acids are the acids more commonly employed, while sodium, potassium, and ammonium hydrates, the various soaps, etc., are the alkalies used.

As these bodies for the greater part are considered in this work more in detail under the head of Caustics, etc., they are best consulted in those chapters. Only a few will be considered in this place.

Ăcidum Sulphurōsum—Ăcidi Sulphurōsi—Sulphurous Acid. *U. S. P.*

Origin.—A liquid composed of not less than 6 per cent. by weight of sulphur dioxide and about 94 per cent. of water.

Description and Properties.—A colorless liquid, of the characteristic odor of burning sulphur, and of a very acrid, sulphurous taste. It should be kept in dark-colored, glass-stoppered bottles, in a cool place, and protected from light.

Dose.—½–2 fluidrams (1.8–7.39 Cc.) [30 minims (2 Cc.), U. S. P.].

Physiological Action.—*Externally and Locally.*—Sulphurous acid is a powerful deoxidizing agent. It easily abstracts oxygen from organic bodies, the acid being a powerful disinfectant, antiseptic, deodorant, and parasiticide.

Internally.—The disinfecting properties of sulphurous acid are less apparent when the drug is ingested than when it is used externally.

Therapeutics.—*Externally and Locally.*—As an antiseptic, disinfectant, and deodorant sulphurous acid may be employed in the treatment of various *parasitic skin diseases*, and a solution of sulphurous acid affords an efficient application to the throat in *pharyngitis*, particularly the gangrenous form, *diphtheria*, etc.

According to Dujardin-Beaumetz, Sollaud, and Balbaud, nonfebrile *pulmonary phthisis* is often favorably influenced by the daily inhalation for a short time of sulphurous-acid vapor. This disagreeable, not to say dangerous, method of treatment has neither been generally adopted nor proved to be of established efficacy.

The acid is a useful antiseptic to apply to recent *wounds*, and may be employed to disinfect the *dejections* of the sick. The fumes of sulphur are worthless as general disinfectants. They may be of service in killing mosquitoes, but dry fumes are practically inert so far as their action on bacteria is concerned. Burning sulphur as a means of disinfection is largely a fetish founded on ancient and superstitious ideas regarding infectious diseases.

Internally.—Sulphurous acid is seldom used internally, though, owing to its powerful antifermentative properties, it has been employed in so-called *fermentative dyspepsia, intestinal fermentation*, and *urticaria*. While it checks fermentation in the laboratory, its effect is less certain in the body; nor can the internal administration of the drug be regarded as satisfactory.

Administration.—Sulphurous acid should be given well diluted with water.

Sōdii Sŭlphis—Sōdii Sulphītis—Sodium Sulphite. *U. S. P.*

Origin.—Prepared by saturating a solution of sodium carbonate or caustic soda with sulphur-dioxide gas. It should contain in the uneffloresced and air-dried condition not less than 96 per cent. of pure sodium sulphite.

Description and Properties.—Colorless, transparent, monoclinic prisms; odorless, and having a cooling, saline, sulphurous taste. In the air the salt effloresces and is slowly oxidized to sulphate. Soluble in 2 parts of water; sparingly soluble in alcohol. It should be kept in well-stoppered bottles, in a cool place.

Dose.—5–60 grains (0.3–4.0 Gm.) [15 grains (1 Gm.), U. S. P.].

Sōdii Bisŭlphis—Sōdii Bisulphītis—Sodium Bisulphite. *U. S. P.*

Origin.—Prepared from sodium carbonate or bicarbonate and sulphur dioxide. It should contain not less than 90 per cent. of pure sodium bisulphite.

Description and Properties.—Opaque, prismatic crystals, or a granular powder, exhaling an odor of sulphur dioxide, and having a disagreeable, sulphurous

taste. Exposed to the air, the salt loses sulphur dioxide and is gradually oxidized to sulphate. Soluble in 3.5 parts of water and in 70 parts of alcohol. The drug should be kept in a cool place, in small, well-stoppered bottles, filled as full as possible.

Dose.—5–30 grains (0.3–2.0 Gm.) [7½ grains (0.5 Gm.), U. S. P.].

Sōdii Thiosŭlphas—Sōdii Thiosulphātis—Sodium Thiosulphate. *U. S. P.*

Origin.—Prepared by passing sulphurous anhydride into a solution of sodium carbonate with salts. It should contain not less than 98 per cent. of pure sodium thiosulphate.

Description and Properties.—Colorless, transparent, monoclinic prisms; odorless, and of a cooling, afterward bitter, taste. Soluble in 0.35 part of water at 25° C.; insoluble in alcohol. It should be kept in well-stoppered bottles.

Dose.—5–20 grains (0.3–1.3 Gm.) [15 grains (1 Gm.), U. S. P.].

Physiological Action and Therapeutics of Sodium Sulphite, Bisulphite, and Thiosulphite.—These substances are feeble germicides and antiseptics, checking putrefaction and other forms of fermentation. It is supposed that they are decomposed in the stomach, liberating sulphurous anhydride; on which assumption they have been given to arrest *gastric fermentation* and as remedies in *typhoid* and *yellow fevers*, *diphtheria*, *erysipelas*, etc. The hypothesis, however, upon which they have been thus hopefully employed has not been confirmed by clinical experience.

These drugs have nevertheless proved efficacious in the treatment of *scabies*, *sycosis*, *impetigo*, *favus*, etc. Atomized solutions of sodium hyposulphite inhaled are beneficial in *gangrene of the lungs*, *fetid bronchitis*, etc.

Administration.—The foregoing preparations of sulphur may be given in solution or in this form applied topically. The sodium thiosulphite may be applied in the form of an ointment.

BORIC ACID AND BORATES.

Ăcidum Bŏricum—Ăcidi Bŏrici—Boric Acid. *U. S. P.*

(BORACIC ACID.)

Origin.—Found native in Northern Tuscany. It may be prepared by the action of hydrochloric acid on borax, filtration, and recrystallization.

Description and Properties.—Transparent, colorless scales, of a somewhat pearly luster, or, when in perfect crystals, six-sided, triclinic plates, slightly unctuous to the touch, odorless, of a faintly bitterish taste, permanent in the air. Soluble in 25.6 parts of water, 15 parts of alcohol, and 10 parts of glycerin. The addition of hydrochloric acid increases its solubility in water.

Dose.—5–15 grains (0.32–1.0 Gm.).

Official Preparations.

Glyceritum Boroglycerini—Glyceriti Boroglycerini—Glycerite of Boroglycerin (GLYCERITE OF GLYCERYL BORATE—SOLUTION OF BOROGLYCERIDE).—Boric acid, 310; glycerin, to 1000. For external use.

Unguentum Acidi Borici—Unguenti Acidi Borici—Ointment of Boric Acid.—A 10 per cent. ointment made with paraffin and white petrolatum. Similar to the Unguentum Acidi Borici of the British and German Pharmacopœias.

Liquor Antisepticus—Liquoris Antisepticus—Antiseptic Solution.—A solu-

tion of mild aromatics and antiseptics similar to certain commercial preparations. Among other things it contains about 2 per cent. of boric acid, 0.1 per cent. each of benzoic acid and thymol, and 25 per cent. of alcohol.

Dose.—Average dose: 1 fluidram (4 Cc.), U. S. P.

Sŏdii Bōras—Sŏdii Borātis—Sodium Borate. *U. S. P.*

(BORAX.)

Origin.—Prepared by boiling together solutions of boric acid and sodium carbonate, the borax crystallizing out. It is also found in a native state on the shores of certain lakes and as a crystalline deposit in the borax lake of California.

Description and Properties.—Colorless, transparent, monoclinic prisms, or a white powder, inodorous, and of a sweetish, alkaline taste; slightly efflorescent in warm, dry air; soluble in 16 parts of water and in 1 part of glycerin; insoluble in alcohol.

Dose.—5–30 grains (0.32–2.0 Gm.).

Antagonists and Incompatibles.—The incompatibles of BORAX are the acids and metallic salts. Morphine and cocaine are precipitated from solutions by BORAX. BORIC ACID is also incompatible with the carbonates and bicarbonates, and with the alkaline, earthy, and metallic bases.

Synergists.—The action of BORAX is enhanced by alkalies and substances promoting waste; that of BORIC ACID, by the antiseptics.

Physiological Action.—*Externally and Locally.*—BORAX is absorbent, protectant, sedative, and antiseptic. Applied to the unbroken skin, it acts upon the epidermis as a soap. By removing the stimulus to secretion and lessening irritation borax checks the secretion of the salivary glands.

BORIC ACID possesses properties similar to those of borax, although more of an antiseptic and antipruritic. It has also an exsiccant and detergent influence. It is a very weak acid and shows little hydrogen ion action.

Internally.—In a general way the action of BORAX is analogous to that of the alkalies. It is refrigerant and diuretic, and by its immediate action upon the womb serves as an emmenagogue, large doses contracting the uterine muscles and acting as an ecbolic. Excessive doses of either of these drugs act as gastro-intestinal irritants.

BORIC ACID, though stronger, resembles borax in its action. Both substances, especially boric acid, retard the action of saliva upon starch, increasing that of the pancreatic juice upon albuminous substances, and increase gastric digestion. Immoderate doses of BORIC ACID check gastric digestion.

The drug is a moderate antipyretic, and when injected in large amounts into the circulation may occasion paralysis of the motor nerves and muscles.

Absorption and Elimination.—It is eliminated by the saliva, perspiration, feces, and urine, the latter being, according to Gies, diminished in quantity. The amount of nitrogen and solid matter ex-

creted with the feces is also increased, as well as the elimination of urea in the urine.

Untoward Action.—BORIC ACID absorbed from boric-acid dressings has occasioned the following untoward symptoms; frequent desire to micturate; nausea, vomiting, and other gastric disturbances; small, weak pulse; sleeplessness, muscular weakness, dimness of sight, depression, headache, hiccough, and various cutaneous eruptions, particularly eczema and psoriasis. Some of the untoward symptoms have seemed to arise in people who ate food preserved by borax (see Wiley's Report, U. S. Bureau of Chemistry).

Poisoning.—The symptoms of poisoning are analogous to those just described.

Treatment of Poisoning.—The treatment of poisoning should be symptomatic; stimulants, morphine, etc., being employed.

Therapeutics.—*Externally and Locally.*—Both borax and boric acids are valuable as local remedies in the treatment of many disorders of the ear, nose, and throat, such as *acute* and *chronic nasal catarrh*, *pharyngitis*, *gingivitis*, and *acute hoarseness.*

An efficient domestic remedy in *aphthæ* affecting the mouths of nursing children is a mixture of BORAX and honey.

An invaluable antiseptic application in *acute conjunctivitis* is a saturated solution of BORIC ACID, and the dry powder serves as an efficient remedy in otorrhea.

Leukorrhea, *gonorrhea*, and *chronic cystitis* are greatly benefited by solutions, in various strengths, of either or both of these drugs. Sir James Simpson recommends a solution of BORAX, 5–10 grains (0.32–0.6 Gm.) to 1 ounce (30.0 Cc.) of hot water, for the *eruption* occurring on the mucous membrane of the vulva in young girls.

It is invaluable as a bland, unirritating antiseptic in general surgery, and in diseases of the eye, ear, nose, throat, and skin.

It should be borne in mind, however, that the antibacterial action of these compounds is very slight, and only concentrated solutions are of any avail. In otitis media it can be used in alcoholic solution, the evaporation of the alcohol leaving the pure substance behind.

Internally.—BORAX is used internally more than boric acid. While in *epilepsy* inferior to the bromides, there are cases uninfluenced by the latter remedies which respond favorably to borax.

Its value in epilepsy is very questionable unless one ascribes it to its antibacterial action in the intestines, thus limiting putrefactive processes in this viscus.

In *chronic cystitis* 5-grain (0.3 Gm.) doses of BORIC ACID three times a day are useful.

These drugs have been used internally in the *summer diarrhea of children.*

Administration.—The remedies may be given in capsules or solution. The taste of borax may be disguised by coffee, syrup of orange, or aromatic elixir of licorice, the drug not being administered with glycerin, lest an acid reaction occur.

The newly introduced *liquor antisepticus* is a convenient mode to prescribe a cheap antiseptic lotion.

Potăssii Dichrōmas—Potăssii Dichromātis—Potassium Dichromate. *U. S. P.*

Origin.—Prepared by roasting in a reverberatory furnace potassium carbonate and chrome-iron ore, with the addition of lime or chalk to prevent fusion. The potassium dichromate formed is separated by crystallization from its solution in water acidulated with sulphuric acid.

Description and Properties.—Large orange-red, transparent triclinic prisms or four-sided tables, odorless, and having a bitter, metallic taste. Permanent in the air; soluble in 19 parts of water; insoluble in alcohol.

Dose.—$\frac{1}{100}$–1 grain (0.0006–0.06 Gm.) [$\frac{1}{6}$ grain (0.01 Gm.), U. S. P.].

Antagonists and Incompatibles.—Potassium dichromate is incompatible with soluble salts of silver, mercury, and lead, and with liquor potassæ, liquor sodæ, and ammonia water.

Synergists.—Agents promoting waste, antiseptics, and caustics.

Physiological Action.—*Externally and Locally.*—In substance potassium dichromate is an irritant caustic, and, according to Miquel, an antiseptic in the proportion of 1 to 909.

Internally.—Its action is nearly identical with that of potassium chlorate, with the additional properties of an expectorant, emetic, and mild alterative.

Poisoning and *treatment of poisoning* do not differ essentially from those of potassium chlorate.

Therapeutics.—*Externally and Locally.*—Potassium dichromate is used as a caustic for *warts*, *corns*, *chancres*, *chancroids*, *mucous patches*, etc., and is also of considerable value as a gargle in *pharyngitis*.

Internally.—Frazer has recently recommended this drug in the treatment of *dyspepsia* and *gastric ulcer*, claiming that the pain, nausea, vomiting, and tenderness may be readily allayed by doses of $\frac{1}{12}$ to $\frac{1}{6}$ grain (0.005–0.01 Gm.), taken upon an empty stomach three times a day. In *acute gastric ulcer* he has perceived no benefit so far as its effect upon the hemorrhage is concerned, the most desirable action of the drug in the latter condition being derived from its antiseptic and analgesic influence.

Potassium dichromate, in doses of $\frac{1}{100}$ grain (0.0006 Gm.) every hour or two, has proven of service in *aphonia* and *hoarseness* due to excessive action of the vocal cords or resulting from an acute cold.

Potăssii Chlōras—Potăssii Chlorātis—Potassium Chlorate. *U. S. P.*

Origin.—Prepared by passing chlorine into a mixture of potassium carbonate and slaked lime. By subsequent boiling in water the chlorate separates by crystallization.

Description and Properties.—Colorless, lustrous, monoclinic prisms or plates, or a white powder, odorless, and having a cooling, saline taste; permanent in the air; soluble in 16 parts of water; insoluble in absolute alcohol. Potassium chlorate should be kept in glass-stoppered bottles. *Great caution should be observed* in handling

the salt, since dangerous explosions are liable to occur when it is mixed with organic matters—cork, tannic acid, sugar, etc.—or with sulphur, antimony sulphide, phosphorus, or other easily oxidizable substance, or upon being either heated directly or subjected to trituration or concussion.

Dose.—3–20 grains (0.2–1.3 Gm.) [4 grains (0.25 Gm.), U. S. P.].

Official Preparation.

Trochĭsci Potăssii Chlōratis—Trochĭscos (acc.) **Potăssii Chlorātis—Troches of Potassium Chlorate.**—Each troche contains $2\frac{1}{2}$ grains (0.15 Gm.).—*Dose,* 1 to 4 troches.

Antagonists and Incompatibles.—In addition to those substances mentioned with which potassium chlorate forms explosive compounds, mixture with glycerin and the hypophosphites is liable to produce similar dangerous results.

Synergists.—Agents promoting waste increase the activity of the drug.

Physiological Action.—*Externally and Locally.*—It is slightly detergent and stimulant, antiseptic and astringent, being irritant when applied in concentrated solution to ulcerated surfaces.

Internally.—*Digestive System.*—Beyond the cool, salty, and persistent taste medicinal doses have little effect; poisonous doses excite violent gastro-intestinal irritation, nausea, bloody vomiting, diarrhea, and jaundice.

Circulatory System.—Small doses of potassium chlorate tend to depress and subsequently raise arterial tension, accelerating the pulse; large doses lower arterial pressure alarmingly; toxic doses convert the hemoglobin of the blood into methemoglobin, the disorganized fluid appearing in the urine. Postmortem lesions are—enlargement of the liver, spleen, and kidneys, with evidences of marked inflammation over the whole intestinal tract.

Nervous System.—Medicinal doses are inert. Toxic doses may produce delirium and death, preceded by coma or convulsions.

Respiratory System.—Large doses act as a depressant to the respiratory apparatus.

Absorption and Elimination.—The drug is absorbed with considerable rapidity, being chiefly eliminated by the salivary glands unchanged. The drug does not increase the urinary flow, large doses, on the contrary, tending to suppress it.

Temperature.—Unaffected by medicinal doses, but lowered by toxic amounts.

Untoward Action.—Small doses of potassium chlorate seldom produce untoward symptoms, although in rare instances eruptions of an erythematous, papular, or vesicular nature have followed the use of the drug. Digestive disturbances occasionally ensue, as well as pain in the region of the kidneys and albuminuria.

Poisoning.—In a few recorded cases of poisoning there were observed a continuous sensation of choking, excessive thirst, persistent vomiting, pain in the abdomen and renal tract, and violent hiccough. Accompanying symptoms were—a small and rapid pulse and faintness, while the urine was albuminous and diminished

in quantity; epistaxis was present; the eyes and lips were cyanotic, and the skin slightly jaundiced and markedly anemic; the liver and spleen were slightly enlarged; and there were alternating sensations of cold and heat, with drowsiness, ending in coma and death.

Treatment of Poisoning.—The stomach should be emptied as quickly as possible and demulcents administered. The patient should be treated symptomatically, and it may be advisable to practice venesection, followed by transfusion of blood, as suggested by Landerer.

Therapeutics.—*Externally and Locally.*—A solution of this drug has been applied with some success in *foul ulcers* and *moist eczema.* Like the potassium permanganate, it has been employed in various *diseases of the nose and throat*, and is especially serviceable in *ptyalism* and *aphthous ulceration.* As a remedy for *syphilitic mucous patches* and *herpes of the buccal cavity* it is of considerable value. It is more efficient in *acute* than in *chronic pharyngitis.*

It possesses marked cicatrizing power, advantage of which property has been taken in the treatment of *phagedenic sores*, the powdered drug being used for this purpose. It is thought that enemas of potassium chlorate solution favor the healing of *rectal ulcers.*

Internally.—As a remedial agent this drug has not met with the success prophesied by many physicians. It has found some advocates as a *genito-urinary* antiseptic and as a remedy in *typhoid fever.*

Yet, notwithstanding the extravagant, though isolated, reports concerning the great value of the drug, its utility has not been universally recognized; indeed, so good an authority as Marchand declares that "chlorate of potassium should be entirely rejected in practice, and particularly in the treatment of children."

Administration.—It may be given in the form of troches, powder, tablets, or a solution, an agreeable means of administration being in aërated water. Owing to its tendency to decomposition when combined with other substances, the drug should be prescribed alone.

IV. HALOGENS.

The haloid compounds of fluorine, chlorine, bromine, and iodine all possess specific germicidal properties. They depend for their action on the presence of the freed haloid substance.

Fluorine is too active a substance to be handled, and only in exceptional cases are bromine-liberating compounds applicable. The halogens are only useful in the presence of a certain amount of moisture. A 2 per cent. solution of chlorine water is capable of acting on the anthrax bacillus spores in 15 seconds, and in proportions of 1 : 700 it will completely prevent the development of this micro-organism. The disinfecting power of the chlorine-containing compounds is much enhanced if nascent chlorine is being

formed. Chlorinated lime is a useful disinfectant for house purposes. Typhoid urine is well disinfected if the chlorinated lime is present in solution 1 : 500 to 1 : 1000 in five minutes. In the stools, the presence of albuminous material and salts makes it imperative to use this disinfectant as strong as 1 to 2 per cent., and have it act at least ten minutes.

Iodine used locally is a powerful germicide and it may also be used internally.

Iodine in combination with various aromatic or fatty bodies may be discussed here to advantage. The most characteristic of these bodies is iodoform. It is necessary that these bodies should liberate free iodine to be active germicides.

Līquor Chlōri Compŏsitus—Liquōris Chlōri Compŏsiti—Compound Solution of Chlorine. *U. S. P.*

Origin.—An aqueous solution of chlorine, containing when freshly prepared about 0.4 per cent. of chlorine, with some oxides of chlorine and potassium chloride.

Description and Properties.—A clear, greenish-yellow liquid, having the suffocating odor and disagreeable taste of chlorine, and leaving no residue on evaporation. Chlorine water, even when kept from light and air, is apt to deteriorate; when it is required of full strength, it should be freshly prepared.

Dose.—1–4 fluidrams (3.7–15.0 Cc.) [1 dram (4 Cc.), U. S. P.].

Antagonists and Incompatibles.—The salts of lead and silver are incompatible.

Synergists.—The antiseptics are theorectically synergistic, though practically the drug is almost always used alone.

Physiological Action.—*Externally and Locally.*—Chlorine water is a powerful antiseptic, germicide, and deodorant. When applied to the skin it acts as a rubefacient and vesicant, while the vapor is distinctly irritating to the respiratory passages.

Internally.—Chlorine water is more or less irritating to the mucous membrane of the stomach, and possesses an astringent taste.

Therapeutics.—*Externally and Locally.*—Chlorine water is still occasionally used as an antiseptic and deodorant in *gangrenous* or *sloughing wounds* and for disinfecting *foul discharges*, etc. It has proved beneficial as a local application in *aphthous stomatitis*, *diphtheria*, and *parasitic skin diseases.*

Administration.—When given internally the drug should be well diluted. Should poisoning ensue from the ingestion of excessive amounts, albumen is the best antidote; for the irritation occasioned by the inhalation of chlorine gas steam-inhalations are indicated.

Călx Chlorināta—Călcis Chlorinātæ—Chlorinated Lime. *U. S. P.*

Origin.—A compound resulting from the action of chlorine upon calcium hydroxide, and containing not less than 35 per cent. of available chlorine.

Description and Properties.—A white or grayish-white, granular powder, exhaling the odor of hypochlorous acid; of a repulsive saline taste, and becoming moist and gradually decomposing on exposure to air. It is but partially soluble in water or alcohol. The drug should be kept in well-closed vessels, in a cool and dry place. Used externally.

Physiological Action and Therapeutics.—Chlorinated lime is a powerful disinfectant, yielding, when exposed to air, hypochlorous acid, which is resolved into chlorine and chloric acid, the last in turn yielding chlorine.

The effects of the drug are therefore analogous to those of chlorine, yet almost the only use which chlorinated lime serves is in disinfecting cesspools and utensils employed for receiving the dejections of invalids.

Līquor Sōdæ Chlorinātæ—Liquōris Sōdæ Chlorinātæ—Solution of Chlorinated Soda. *U. S. P.*

(LABARRAQUE'S SOLUTION.)

Origin.—An aqueous solution of several chlorine compounds of sodium, containing at least 2.4 per cent. by weight of available chlorine.

Description and Properties.—A clear, pale-greenish liquid, having a faint odor of chlorine and a disagreeable alkaline taste. It should be kept in well-stoppered bottles, protected from light. Used externally.

Physiological Action.—The action of the drug resembles that of aqua chlori, although it is feebler than the latter.

Therapeutics.—Solution of chlorinated soda is used as a disinfectant for *fetid ulcers*, *gangrenous sores*, and *ozena*, and as a disinfectant wash in *diseases of the uterus*, *vagina*, and *auditory canal.*

Administration.—There are no special directions to be observed in the application of this solution.

Iodofŏrmum—Iodofŏrmi—Iodoform. *U. S. P.*

Definition.—Triiodomethane, usually obtained by the action of iodine upon alcohol, in the presence of an alkali or alkali carbonate.

Description and Properties.—Small, lemon-yellow, lustrous crystals, of the hexagonal system, having a peculiar, very penetrating, and persistent odor, somewhat resembling that of saffron and iodine, and an unpleasant, slightly sweetish, and iodine-like taste. It is very slightly soluble in water, to which, however, it imparts its odor and taste; soluble in about 46.7 parts of alcohol, in about 12 parts of boiling alcohol, or in 5.2 parts of ether, and very soluble in chloroform, benzin, and fixed and volatile oils.

Iodoform is slightly volatile, even at ordinary temperatures, and in boiling water distils slowly over with its vapor. It should be kept in well-stoppered bottles, in a cool and dark place.

Iodoform contains 96.69 per cent. of its weight as iodine.

Dose.—1–3 grains (0.06–0.2 Gm.) [4 grains (.250 Gm.), U. S. P.].

Official Preparation.

Unguentum Iodoformi—Unguenti Iodoformi—Ointment of Iodoform.—10 per cent. Used externally.

Iodōlum—Iodōli—Iodol. *U. S. P.*

Definition.—Tetraiodopyrrol, a derivative of the base pyrrol (C_4H_5N), obtained by the direct action of iodine upon the base in the presence of alcohol.

Description and Properties.—A light, grayish-brown, crystalline powder without odor or taste. Very slightly soluble in water (1 : 4900), much more so in alcohol (1 : 9), soluble in fixed oils.

Dose.—Average dose: 0.250 Gm. = 250 milligrammes (4 grains, U. S. P.).

This is one of the vast number of compounds proposed in the last few years as substitutes for iodoform. The iodine of iodol is apparently less easily split off the molecule than that of iodoform, and it is said to be less liable to produce poisoning. Iodol contains about 88.57 per cent. of iodine.

Allied Compounds.

Antiseptol—Cinchonine Iodosulphate.—*Origin.*—It is prepared by mixing an aqueous solution of cinchonine sulphate with an aqueous solution of iodine and potassium iodide, and washing and drying the resulting precipitate.

Description and Properties.—It occurs as a light reddish-brown powder, insoluble in water, but soluble in alcohol and chloroform. It contains about 50 per cent. of iodine.

Dose.—1–3 grains (0.06–0.2 Gm.).

Aristol—Dithymol Diiodide.—*Origin.*—It is obtained by adding a solution of iodated iodide of potassium to an aqueous solution of hydrate of sodium containing *thymol.* The resulting precipitate is washed and subsequently dried at ordinary temperature.

Description and Properties.—A dark, brownish-red, amorphous, almost tasteless powder, of a slight, peculiar, iodine-like odor, insoluble in water and glycerin, sparingly soluble in alcohol, but readily soluble in ether, collodion, and chloroform. It is also taken up by fixed oils, petrolatum, etc.

Aristol is decomposed by heat and light, and it should be kept in dark amber-colored, well-stoppered bottles. It contains 45.8 per cent. of iodine.

Dose.—It is not given internally.

Europhen.—Prepared in a manner analogous to that of preparing aristol, expect that isobutylorthocresol is used in place of thymol.

Description and Properties.—An amorphous, yellow powder, having an odor resembling saffron; soluble in ether, chloroform, and fixed oils; insoluble in water and glycerin. It is permanent in dry air, but when moistened with water resolves into iodine, forming a new soluble iodine compound. When heated to 110° C. (230° F.) it melts, forming a clear brown liquid. It contains 27.6 per cent. of iodine.

Dose.—¼–1½ grains (0.016–0.09 Gm.). It is used hypodermically in olive oil, and externally in the form of an ointment, in strengths varying from 3 to 10 per cent.

Antagonists and Incompatibles.—It is incompatible with the preparations of mercury and zinc, with metallic oxides, and with starch.

Losophan.—*Origin.*—Prepared by slowly adding an aqueous solution of iodine and iodide of potassium to an aqueous solution of ortho-oxyparatoluic acid and sodium bicarbonate. The precipitate formed is washed with water and recrystallized from alcohol.

Description and Properties.—It occurs as colorless, odorless, needle-shaped crystals. Insoluble in water and alcohol, but readily soluble in ether, benzene, chloroform, and fixed oils. It contains 78.39 per cent. of iodine.

Dose.—It is used externally.

Sozoiodol.—*Origin.*—A combination of iodine 54 per cent., carbolic acid 20 per cent., and sulphur 7 per cent.

Description and Properties.—The sodium, potassium, ammonium, mercury, lead, and zinc salts of this acid are the preparations used, the sodium salt being the one most commonly employed. The *sodium sozoiodolate* occurs in bright, prismatic, needle-shaped crystals. Soluble in water, alcohol, and glycerin.

Dose.—For external use, in strengths varying from 3 to 20 per cent.

Sulphaminol.—*Origin.*—It is formed by the action of sulphur on the salts of metaoxydiphenylamine.

Description and Properties.—It is a yellow powder, insoluble in water, readily soluble in alkalies, alcohol, and glacial acetic acid.

Dose.—1 to 4 grains (0.006–0.25 Gm.).

Other compounds of iodine used for much the same purposes are: *Iatrol*, aniline iodine, an antiseptic powder; *imidiol*, a substitute for iodoform; *iodoanisol*, a rubefacient and antiseptic; *iodocasein*, a yellow powder with faint iodine odor; *iodocrol*, carvol and potassium iodide and soda; odorless substitute for iodoform; *iodoformal*, with odor like vanilla, also an iodoform substitute; *iodoformogen*, albumin and iodoform; *iodogallicin*, bismuth iodide and gallicin, antiseptic; *iodoterpin*, iodin and terpin, dark-brown liquid, substitute for tincture of iodine or iodoform; *iodothymoform*, an iodized thymol-formaldehyd preparation, a yellow powder rich in iodine. *Nosophen*, *antinosine*, *eudoxine*, are iodine compounds of phenolphthalein. *Loretin* and *vioform*, compounds of cresol and iodine. *Airol*, a 20 per cent. iodine compound with bismuth and gallic acid.

Antagonists and Incompatibles.—Iodoform is incompatible with mercuric chloride.

Physiological Action.—*Externally and Locally.*—Iodoform or-

dinarily possesses no irritating action when applied to the skin or mucous membranes, or to ulcers and wounds. On the contrary, it possesses analgesic properties. It has a tendency to check serous oozing when applied to wounds. It has a limited action in hindering the growth of bacteria when in alkaline serum, but as a dry powder it seems to possess little bactericidal action.

Internally.—Digestive System.—Small doses, if they have any effect, slighly increase the appetite, and tend to increase the salivary, biliary, and intestinal secretions. Large doses disturb the stomach, and may occasion nausea, vomiting, and diarrhea.

Circulatory System.—Small doses retard and strengthen the pulse, and, for a brief period only, increase arterial tension. Full medicinal doses lessen arterial tension and render the pulse slower and weaker. Lethal doses rapidly accelerate the pulse, causing it to become irregular; later, the action of the heart is slowed, and finally arrested in diastole, from paralysis of the cardiac muscle.

Nervous System.—Large doses are apt to produce headache, restlessness, delirium, or stupor. The reflexes may be depressed, or in some cases choreic movements may appear. Muscular contractility and the excitability of the nerve-centers to external stimulation are lessened.

Respiratory System.—Very large doses produce convulsive respiratory movements.

Absorption and Elimination.—Iodoform is absorbed from the stomach, or from mucous membranes or wounds to which it is applied. It is slowly absorbed from the alimentary canal, but readily absorbed from wounds. In the tissues it combines with the proteid molecules, and is retained in the system in part as potassium iodide and other iodides. Free iodoform is, however, found in the body, else poisoning would probably not develop. It is eliminated in all the secretions, and has been detected in the urine and saliva within one hour after its administration, traces of it being perceptible in the secretions for three days. Iodine is liberated at the points of elimination, either as an iodate or as some organic compound of iodine, or both. The drug is also detected in the breath, though it is chiefly eliminated in the urine as alkaline sodium iodate, coloring the urine yellow. It should be remembered that iodoform is absorbed much more rapidly than it is eliminated.

Temperature.—Large doses cause a rise of temperature, while poisonous doses may, at the last, produce a decided reduction of animal heat.

Untoward Action.—Sometimes iodoform excites an eczematous eruption, which may be papular or erythematous, and symptoms of vertigo. Muscular weakness and double vision have also been observed; sleepiness, alternating with excitement; incoherence of speech; headache; mental confusion; and amblyopia.

Poisoning.—Three forms of poisoning by iodoform are described by Duret—the eruptive, the cerebral, and the syncopal. The relation of iodoform to the methane group is to be borne in mind.

No two cases of poisoning present the same symptoms, hence every case should be considered a law unto itself and be treated accordingly. With reference to fatal doses, 75 grains (5 Gm.), administered over a period of one week, have caused death.

In the first of these there may be a severe and extensive erythema or eczematous eruption. The cerebral variety is characterized by an increase of temperature and accelerated pulse—as high as 150 or 175 per minute; great irritation of the gastro-intestinal tract; widely dilated, or motionless and contracted, pupils; intense headache over the entire circumference of the head; insomnia, restlessness, melancholia; great depression of spirits or hallucinations and active delirium or suicidal mania.

In the syncopal variety the patient complains of dizziness and mental confusion; is languid and weak; he suffers from insomnia, is restless, and unable to keep quiet. He may develop hallucinations either of an exciting or depressing nature, and may develop violent delirium; the heart's action becomes very rapid and feeble, the patient passing at length into a lethargic or comatose condition, with paralysis of the sphincters, and finally dying, perhaps quite suddenly.

The symptoms of poisoning may appear soon after the application of the drug, or they may be deferred for days and even weeks. In the latter case, which may properly be termed chronic poisoning, the patient is more apt to be depressed, weak, and apathetic with slight fever and accelerated pulse. Old people are the more susceptible to its toxic influence.

Treatment of Poisoning.—Every particle of the drug should be immediately removed from the body and its internal administration be discontinued at once. Stimulants, diaphoretics, and diuretics should be given, with frequent bathing of the body in warm water, to hasten elimination. Opium and large doses of potassium bicarbonate have been recommended.

Therapeutics.—*Externally and Locally.*—IODOFORM acts as an alterative, analgesic, protectant, antiseptic, and germicide to at least some forms of bacilli. Its extremely disagreeable odor does not commend it for anything. Odorless compounds with similar actions are much to be preferred. It is a valuable application to *wounds*, *ulcers*, etc. It is especially valuable in the treatment of *tuberculous affections*, such as *tuberculous joints*, when it is used in the form of an injection—10 to 20 per cent.—in sterilized olive oil. In *tuberculous parenchymatous synovitis* the mixture is injected directly into the joint-cavity.

Iodoform is an exceedingly valuable application to *syphilitic ulcers*, *chancres*, *chancroids*, *suppurating buboes*, *ulcerations of the uterus*; *uterine cancer*, and *indolent* and *irritable ulcerations of the leg*.

Incorporated in a suppository, it is very efficacious in painful *hemorrhoids*, *fistula*, and *fissure of the anus*.

It is a valuable application in many diseases of the *ear*, *nose*, *throat*, *eye*, and *skin*, where a drug of this character is indicated.

Internally.—IODOFORM is used but very little internally, and has no particular indications.

The allied compounds here mentioned are used locally as substitutes for iodoform. Most of them possess the great advantage of being odorless, and some of them seem to be in all respects quite as efficient as iodoform. ARISTOL is undoubtedly superior to it in the treatment of *indolent ulcers* and in many *diseases* of the *skin*, *ear*, *nose*, and *throat*. EUROPHEN and IODOL should certainly replace iodoform in many cases.

Administration.—Internally, iodoform should be given in pills or capsules. Externally, it may be used in the form of a powder, alone or mixed with powdered borax or boric acid. It is also used in the form of an ointment or collodion. It is given hypodermically, mixed with olive oil and glycerin, or dissolved in ether, in strengths varying from 10 to 30 per cent.

Its disagreeable odor may be modified or disguised by mixing it with tar, liquid styrax, balsam of Peru, thymol, coumarin, menthol, ground coffee, oil of lavender, bergamot, bitter almond, coriander, musk, vanilla, or some similar aromatic and pleasantly odorous substance. At best, however, it is almost impossible to eradicate the disagreeable odor.

V. AROMATIC AND FATTY COMPOUNDS.

This group is a large one. The differing compounds, modifications of the benzol nucleus, make a distinct series with closely related properties.

Phēnol—Phenōlis—Phenol. *U. S. P.*

(ACIDUM CARBOLICUM, U. S. P. 1890.)

Definition.—Hydroxybenzene, obtained either from coal tar by fractional distillation and subsequent purification, or made synthetically. It should contain not less than 96 per cent. of absolute phenol.

Description and Properties.—Colorless, interlaced, or separate needle-shaped crystals, or a white, crystalline mass, sometimes acquiring a reddish tint, having a characteristic, somewhat aromatic, odor, and, when copiously diluted with water, a sweetish taste, with a slightly burning after-taste. Deliquescent on exposure to damp air.

Soluble in about 19.6 parts of water, the solubility varying according to the degree of hydration of the acid; very soluble in alcohol, ether, chloroform, benzol, carbon disulphide, glycerin, and fixed and volatile oils. It is liquefied by the addition of about 8 per cent. of water. The vapor of the acid is highly inflammable. Carbolic acid is faintly acid to litmus-paper. It should be kept in dark amber-colored, well-stoppered bottles.

Dose.—½–2 grains (0.03–0.12 Gm.). If liquefied, 1–2 minims (0.03–0.12 Cc.) [1 grain (0.65 Gm.), U. S. P.].

Official Preparations.

Glycerītum Phenōlis—Glycerīti Phenōlis—Glycerite of Phenol (20 per cent.) [5 minims (0.3 Cc.), U. S. P.].—For external use.

Unguěntum Phenōlis—Unguěnti Phenōlis—Ointment of Phenol (3 per cent.).—For external use.

Phēnol Liquefăctum—Phenōlis Liquefăcti—Liquefied Phenol. *U. S. P.*

Definition.—A liquid composed of not less than 86.4 per cent., by weight, of absolute phenol and about 13.6 per cent., by weight, of water.

It is prepared from phenol (Acidum Carbolicum, U. S. P., 1890) by the addition of distilled water in the proportion of 1 Gm. of the latter to 9 Gm. of phenol. Introduced on account of the ease of dispensing.

Dose.—Average dose: 1 minim (0.05 Cc.). U. S. P.

Physiological Action.—*Externally.*—Carbolic acid destroys micro-organisms. Spore-bearing forms are very resistant to its action. Two per cent. solutions are effective for many bacteria, but they are not always efficient as germicides. Phenol is a local anesthetic, and, applied in full stength to animal tissues, acts as a caustic, but does not produce vesication. In weaker solutions it produces a burning and reddening of the skin. It acts more severely upon mucous membranes. It coagulates albumin, and therefore its caustic action is limited.

The eschar is first whitish, subsequently becoming brownish. It is readily absorbed through the skin or through raw surfaces, and toxic effects have been thus produced. Weak solutions, 2.5 per cent., in contact with an area, such as a finger, may cause gangrene of the parts.

Internally.—Digestive System.—In small doses it is anesthetic and sedative to the stomach. In large or poisonous doses it is a powerful gastro-intestinal irritant. Ordinary medicinal doses are converted by the gastric contents into the sulphocarbolates.

Circulatory System.—Medicinal doses have no apparent effect on the circulation. Large doses first depress, and later accelerate, the heart. Poisonous doses powerfully depress the heart, stopping it in diastole. The arterial tension is lowered by lethal doses.

Nervous System.—Medicinal doses have no special effect upon the nervous system. Large or poisonous doses depress the cerebrum. Vertigo may first be noticed, which is soon followed by stupor. There may be muscular trembling or convulsions.

Respiratory System.—Small doses do not affect the respiration. Large doses first accelerate the respiratory movements, rendering them full, but shallow respirations soon follow. This action is due to stimulation of the vagi, both at the periphery and of the center. If the dose has been a poisonous one, there is great depression, and ultimately paralysis of respiration due to depression of the centers.

Absorption.—It is absorbed from the stomach, and diffuses into the blood with great facility, circulating in that tissue probably as an alkaline carbolate.

Elimination.—It is eliminated by all the secretions—chiefly by the kidneys and lungs—and appears in the urine as salts of sulphocarbolic and glycuronic acids, and to oxidated products of the dioxybenzoles, hydrochinon and pyrocatechin. To the latter substances, after further oxidation, mainly is due the peculiar smoky

or olive-green color imparted to the urine after large or continued doses have been taken. Much of the phenol is eliminated unchanged.

Temperature.—It is not specially affected by small doses. Full medicinal doses tend to lower bodily temperature in fever, while poisonous doses lower the temperature several degrees. The reduction of temperature is due to its diminishing heat-production and increasing heat-dissipation.

Eye.—Poisonous doses almost invariably cause the pupil to be minutely contracted, due, probably, to paralysis of the radiating fibers, the circular fibers being unaffected.

Untoward Action.—Headache, either in the frontal or the occipital region, heaviness and a sensation of fulness in the head, dizziness, and the appearance of rings before the eyes, muscular weakness, especially of the legs, profuse sweating, and extensive formication.

Where there is an idiosyncrasy on the part of the individual against this drug, small doses even may produce the symptoms of poisoning.

Poisoning.—Carbolic acid is one of the most widely used poisons. 8.5 Gm. has caused the death of an adult in fifteen minutes. 3 Gm. in solution thrown into the pleura has caused dangerous symptoms. .13 Gm. rubbed on the skin has caused death. 1.5 Gm. has caused the death of a child after a short time.

The patient is rendered rapidly unconscious or may drop dead in *twelve to fifteen minutes* after taking from respiratory paralysis. Should the dose be insufficient to produce so sudden a death, the patient suffers from all the symptoms of gastro-enteritis—intense pain, with violent vomiting of white slimy mucus and purging. Fibrillary trembling may be present. Stertorous breathing appears, with cold, clammy skin, pinched face, anxious expression, abolition of reflexes, weak, thready, and often imperceptible pulse, feeble respiration, and frequently dyspnea, and death finally occurs from failure of respiration.

Salivation is a common symptom of carbolic-acid poisoning. The characteristic burn of the lips is whitish. The odor is an important diagnostic sign.

As toxic symptoms may be produced by the external application of solutions of carbolic acid, as in surgical dressings or vaginal or intrauterine douches, the toxicity of this drug should be appreciated, and patients carefully watched for the first untoward manifestations, such as pain in the lumbar region, smoky urine, nervousness, and cerebral disturbance, small pulse, depressed temperature, hot and cold flashes, etc., when the drug should be immediately withdrawn.

Treatment of Poisoning.—The immediate and frequent washing out of the stomach with administration of magnesium sulphate (Epsom salts), sugar and lime solution (lime water, sugar 3, and water 12), and warm demulcent drinks should be resorted to. The application of external heat. Atropine and strychnine hypoder-

mically. Digitalis and coffee may also be required. Opium, or some preparation of it, for the relief of pain.

Alcohol is an efficient antidote if promptly given. Locally applied, it prevents the caustic action of even pure phenol.

Therapeutics.—*Externally and Locally.*—For some time after it was so prominently brought forward by Lister carbolic acid was thought to be indispensable in antiseptic surgery. It is now known that the solutions which are safe to use are inefficient, ordinarily, beyond the mere mechanical effect of washing.

The benumbing influence produced on the hands of the surgeon, and the discoloration of bright instruments and rapid impairment of their cutting surfaces, render strong solutions for disinfecting instruments impracticable, and, indeed, of less value for this purpose than the prolonged boiling in distilled water rendered slightly alkaline with sodium bicarbonate.

The pain of superficial *burns* is relieved by applying strong solutions of carbolic acid, care being taken to prevent absorption.

It is an extremely valuable drug as an antipruritic, and is hence of great utility in the treatment of certain *diseases of the skin—pruritus, chronic eczema.* In *chilblains, tinea tonsurans, tinea capitis, tænia circinata, favus,* etc., it is of value. *Chronic laryngitis,* characterized by diminished secretion, is greatly benefited by the direct application to the parts of a solution of ½ dram to 1 ounce of glycerin (2.0–30.0 Cc.). A spray containing from 2 to 5 grains (0.12–0.36 Gm.) to 1 ounce (30.0 Cc.) of water is an efficient application in the treatment of *acute* and *chronic inflammation of the throat and nose.*

As a deodorant it is valuable to correct the fetor arising from *syphilitic ulcerations, carcinoma, gangrene of the lungs, bronchorrhea, pneumothorax,* etc.

It reduces the discharge and relieves the pain in acute *otitis media:* a 10 per cent. solution in glycerin should be used. It is also of value in the treatment of *otorrhea* and in *acute perforations of the tympanic membrane,* but should be used in much weaker solutions—1 or 2 per cent.

A lotion, 8 to 15 grains (0.5–1.0 Gm.) to 1 ounce (30.0 Cc.), is an efficient antiseptic in *foul* and *indolent ulcers.*

The pure acid is used as a *cauterant* in *chancroids, lupus, gangrene, bites of rabid animals,* etc.

The iodized carbolic acid is a valued local remedy in *endometritis, chronic endocervicitis,* and *ulcers of the cervix.*

Crude carbolic acid is useful as a disinfectant.

Internally.—While inferior to salicylic acid to *check fermentation,* it is nevertheless used for that purpose in *dilatation of the stomach* and so-called *fermentative,* or *flatulent, dyspepsia.*

In nervous and irritative *vomiting* it may be given in doses of from 1 to 2 minims (0.06–0.12 Cc.), well diluted and repeated at intervals of from one to four hours according to the symptoms of the case.

It has been used in *acute* and *chronic dysentery*, and as an anthelmintic against *ascarides* and *tænia solium.*

It has also been advocated as a remedy for *typhoid fever* and in *malarial cachexia*, but purely upon hypothetical grounds, no clinical results having thus far justified its use in these disorders.

Administration.—It may be given internally in pills or capsules, mixed with powdered licorice-root as an excipient, or dissolved in glycerin and well diluted with sweetened water.

For external use various strengths are used (from 1 : 10 to 1 : 500), and the various preparations mentioned may be used according to the case and indications. It is to be noted that a strength above 1 : 10 is liable to produce vesication, and that even in 2 per cent. solutions it has caused gangrene of the part to which it has for some time been applied.

Crēsol—Cresōlis—Cresol. *U. S. P.*

Definition.—A mixture ($C_6H_4<{}^{CH_3}_{OH}$) of three isomeric cresols obtained from coal tar, freed from phenol, hydrocarbons, and water.

Description and Properties.—A colorless or straw-colored refractive liquid having a phenol-like odor and turning yellowish-brown on prolonged exposure to light.

Sometimes erroneously called crecylic acid. Cresol is methyl phenol, the three isomeric forms being known chemically as ortho-, meta-, and paracresol.

Soluble in water (1 : 60) and miscible in all proportions with alcohol and glycerin. Miscible with alkali hydroxide solutions, forming alkali cresolates, homologous with alkali phenolates.

Dose.—Average dose: 1 minim (0.05 Cc.). U. S. P.

Hunt writes "much has been written concerning the germicidal and toxic properties of cresol. It is generally held that cresol is more toxic to bacteria than is phenol, but that it is less toxic to higher animals than is the latter." Tollens (*Arch. f. exper. Path. u. Pharm.*, lii., p. 220, 1905) finds that paracresol is more than twice as toxic for mice as is phenol, orthocresol has the same toxicity, while metacresol is less toxic. Thus the toxicity of a cresol will depend upon the relative proportion of the three constituents, and these seem to vary in different preparations; Tollens finds some specimens to be more toxic than phenol. The U. S. Pharmacopœia does not specifically state the proportions in which the three cresols are present, although it fixes limits for the boiling-point, specific gravity, and solubility. A preparation on the market under the name of *tricresol* (*enterol*) is said to contain 35 per cent. of orthocresol, 40 per cent. of metacresol, and 25 per cent. of paracresol; it is soluble to the extent of 2.2 to 2.55 per cent. in water. The physiological action of the cresols is almost identical with that of phenol.

The cresols are constituents of coal tar and other crude antiseptic substances. Being but slightly soluble in water, they are often used in the form of emulsions or are dissolved with the aid of salts or of soap. The official Liquor Cresolis Compositus (*q. v.*) belongs to the latter class; it is practically identical with the Liquor

Cresoli saponatus of the German Pharmacopœia and the preparation on the market known as *lysol.*

Līquor Cresōlis Compŏsitus—Liquōris Cresōlis Compŏsiti—Compound Solution of Cresol. *U. S. P.*

Definition.—Liquor Cresoli Saponatus is the official German title of a somewhat similar preparation. It is essentially a linseed-oil-soap solution of cresol of 50 per cent. strength; the soap dissolves the cresol as do alkalies. This is a mixture of much more definite composition than many commercial preparations of similar nature. For practical use the 50 per cent. solution is diluted with water to various degrees according to need.

(Crude Carbolic Acid and Cresols.)

Within recent years a number of preparations made from the higher phenols of crude carbolic acid, particularly the cresols, have been placed on the market as disinfectants, and a word should be said concerning their composition and their usefulness. For the most part their composition is extremely complex. They are mixtures of many constituents. Some of the more commonly used are:

1. **Sapocarbol-Creolin—"Carbolic Soaps."**—This is a mixture of crude cresols ($C_6H_4(OH)CH_3$) with pyridin bases, hydrocarbons dissolved in resin soaps.

2. **Saprol.**—A mixture of crude cresols, with petroleum remnants, hydrocarbons, and pyridin bases.

3. **Creolin.**—A mixture of the higher raw phenols from oil in resin soap with an alkaline reaction. Its composition is thought to be hydrocarbons, 45 per cent.; phenols, 13 per cent. (phenol, cresol, xylenol, phlorol); pyridin bases, 2–3 per cent.; resin, 32 per cent.; water, 5–6 per cent.

A ½–2 per cent. solution in water has been used as a germicide in obstetrics, but its cloudy appearance made it unpopular.

4. **Lysol.**—A 50 per cent. solution of the comparatively pure cresols in potassium soap. It is a widely employed germicide in gynecology, and is very useful in ½–1 per cent. solution.

It occasionally is swallowed by accident. 1 dram has killed a ten-months'-old child in thirty-six hours. 25 Gm. of lysol has been recovered from, although the symptoms were exceedingly severe. Poisoning has occurred by its use as a uterine douche.

5. **Salveol** is a mixture of cresol in sodium cresotinate.

6. **Solutol.**—A solution of crude cresols in sodium cresolate.

7. **Tricresol.**—A mixture of the three pure cresols.

Orthometa- and paracresol, soluble in 2–2½ parts of water, is used as an expectorant and respiratory antiseptic.

The pure cresols are about as poisonous as phenol (Meili, *Inaug. Dissert.*, Bern, 1891), but the symptoms of poisoning may be somewhat delayed. As antiseptics Hammerl (*Hygienische Rundschau*, ix., No. 20) has shown that ortho- and paracresol are stronger than carbolic acid.

Resorcīnol—Resorcinōlis—Resorcinol. *U. S. P.*

Definition.—A diatomic phenol [metadihydroxybenzene, $C_6H_4(OH)_2$ 1:3] obtained usually by the reaction of fused sodium hydroxide upon sodium metabenzene-disulphonate.

Origin.—Prepared by melting galbanum, ammoniac, or guaiacum resin with potassa. It is also prepared in a similar manner from asafetida, sagapenum, ascaroid resin, and from phenolsulphonic acid and other derivatives from phenol.

Description and Properties.—Colorless or faintly reddish, needle-shaped crystals, or rhombic plates, having a faint, peculiar odor, and a disagreeable sweetish and afterward pungent taste. Resorcinol acquires a pinkish or brownish tint by exposure to light and air, and should be kept in dark amber-colored vials. It is soluble in 0.5 part of water, more in alcohol, very soluble in boiling water and in boiling alcohol, readily soluble in ether and in glycerin, and very slightly soluble in chloroform. The aqueous solution is neutral or only faintly acid to litmus-paper.

Dose.—3–8 grains (0.2–0.5 Gm.) [2 grains–.125 Gm., U. S. P.].

Allied and Derivative Compounds.

Hydroquinol—Hydroquinone—Hydrochinone—Paradioxybenzene.—Colorless, odorless, dimorphous crystals, having a sweetish taste. Soluble in 17 parts of water, very soluble in hot water, alcohol, and ether. *Dose*, 1½–5 grains (0.03–0.30 Gm.).

Catechol—Pyrocatechin—Orthodioxybenzene.—Acicular crystals, readily soluble in water, alcohol, and ether.

Other allied compounds are—thioresorcin, resopyrine, and fluorescein.

Physiological Action.—Pyrocatechin, resorcin, and hydroquinone, ortho-, meta- and paradioxybenzols, agree practically in all their actions. Pyrocatechin and resorcin are comparatively soluble in water. Hydroquinone is less so. They irritate the central nervous system, more particularly the spinal cord. Resorcin is the least irritating and poisonous of the three; 10 Gm. has been taken without causing death. Pyrocatechin is the most active, both locally and internally. It is more poisonous than phenol.

Therapeutics.—*Externally and Locally.*—Resorcin is especially useful in certain subacute or chronic skin affections, and may be used like salicylic acid in *indurated eczema*. It is of great value in *psoriasis*, *seborrhœa sicca*, *pityriasis capitis*, *sycosis*, *acne rosaceæ*, etc.

A 5 to 10 per cent. solution is an efficient application in *pharyngitis*, *diphtheria*, and *ulcerative laryngitis*. An ointment of resorcin is an excellent application to *foul ulcers*, *sloughing wounds*, and *syphilitic ulcers*.

Condylomata have been cured by dusting upon them powdered resorcin.

A mixture of powdered resorcin and boric acid (1 : 20 or 1 :10) has been used with brilliant results in *suppuration of the middle ear*.

A 2 per cent. solution has been found useful in the form of a spray in *whooping-cough*, while stronger solutions of 10 or 20 per cent. have been used with some success in *hay fever*.

Solutions of resorcin have been used in *gonorrhea* and *cystitis*.

Internally.—Resorcin is preferable to carbolic acid for internal administration, especially in digestive disorders, such as *gastralgia*, *chronic gastritis*, *ulcer of the stomach*, and *fermentative dyspepsia*, so called. Owing to its sedative and antifermentative properties, it is of value in *acute diarrhea* of children.

It has been used with some success in *intermittent fever*, but not with good results sufficiently uniform to justify the exclusion of quinine. As an antipyretic it may be used when a drug of that character is indicated, but it is not equal to antipyrine or acetanilid, and in doses sufficient to produce the desired reduction of temperature it is too depressant to the heart. Its chief therapeutic value is for external or local use, and internally for the digestive disorders above mentioned.

Administration.—It should be given in pills or capsules.

The TRIOXYBENZOLS, $C_6H_3(OH)_3$, pyrogallol (1, 2, 3), oxhydrochinon (1, 2, 4), and phloroglucin (1, 3, 5), are occasionally used in

medicine. Pyrogallol is widely employed as a hair dye, is also employed in the treatment of psoriasis, and widely used in photography. It is highly poisonous. It behaves in a large measure like phenol, but in addition has a marked destructive action on the blood. Oxyhemoglobin is changed into methemoglobin and hemolysis also is energetic.

Phloroglucin used internally causes a peculiar type of diabetes.

Other hydrocarbons of this general group, such as benzol, toluol, xylol, are liquids and not useful, but naphthalin, a solid member of the series, and some of its derivatives, are therapeutically possible.

Naphthalēnum—Naphthalēni—Naphthalene.
U. S. P.

Origin.—A hydrocarbon ($C_{10}H_8$) obtained from coal-tar.

Description and Properties.—Colorless, shining, transparent laminæ, having a strong, characteristic odor resembling that of coal-tar, and a burning, aromatic taste; slowly volatilized on exposure to air. Insoluble in water, but when boiled in it imparting a faint odor and taste. Soluble in 15 parts of alcohol, and very soluble in boiling alcohol; also very soluble in ether, chloroform, carbon disulphide, and in fixed or volatile oils. Naphthalene volatilizes slowly at ordinary temperatures, but rapidly when heated. Its vapor is inflammable, burning with a luminous and smoky flame. It should be kept in well-stoppered bottles.

Dose.—2–10 grains (0.12–0.6 Gm.) [2 grains (0.125 Gm.), U. S. P.].

Bētanăphthol—Bētanaphthōlis—Betanaphthol.
U. S. P.

Origin.—A monatomic phenol occurring in coal-tar, but usually prepared artificially from naphthalene.

Description and Properties.—Colorless or pale buff-colored, shining, crystalline laminæ, or a white or yellowish-white crystalline powder, having a faint, phenol-like odor, and a sharp, pungent, but not persistent, taste. Permanent in the air. Soluble in about 95 parts of water, in 0.6 part of alcohol at 25° C. (77° F.), in about 75 parts of boiling water, and very soluble in boiling alcohol, ether, chloroform, and solutions of caustic alkalies. It should be kept in dark amber-colored, well-stoppered bottles.

Dose.—2–10 grains (0.12–0.6 Gm.) [4 grains (0.250 Gm.), U. S. P.].

Antagonists and Incompatibles.—Physiological antagonists of NAPHTHALENE are the same as for other members of this group. BETANAPHTHOL is incompatible with subacetate of lead.

Synergists.—Carbolic acid and its derivatives.

Physiological Action.—NAPHTHALENE is antiseptic, antifermentative, disinfectant, and deodorant. Its action is quite similar to phenol. It is insoluble in the gastric juices, but to some extent soluble in the intestines, where it acts as an antiseptic by local contact, deodorizing the stools and often imparting to them its own odor. It is absorbed to some extent, and is eliminated by the lungs and kidneys, but escapes principally in the feces. It has been known to irritate the kidneys. It is broken up into naphthol or dioxynaphthalene, and acts as a local antiseptic and disinfectant at points of elimination, but does not occasion any local irritation unless quite large doses have been taken: 15 grains (1.0 Gm.)

daily have occasioned frequent micturition, with burning pain, vesical tenesmus, and redness of the urethral orifice. Purdy states that in certain cases of genito-urinary disease he has known a dose of 5 grains (0.32 Gm.) to cause severe suffering along the whole urinary tract. It is a stimulant expectorant. Its use is thought to bring about a cloudiness of the crystalline lens.

BETANAPHTHOL is quickly absorbed when applied locally. It produces considerable irritation when used in solution, but has no irritating effect when applied in the form of ointment. Toxic effects may result from its absorption by the skin, their character resembling the action of carbolic acid.

Therapeutics.—*Externally and Locally.*—NAPHTHALENE is recommended in the treatment of *scabies* and other *parasitic skin diseases.*

Internally.—It is used in *typhoid fever* and in the *gastro-intestinal* and *genito-urinary disorders* for which salol and carbolic acid are administered, such as *chronic diarrhea* and *dysentery*, *acute* or *chronic cystitis*, etc.

The internal uses of BETANAPHTHOL are the same as those of naphthalene, while externally it may be employed, like carbolic acid or creasote, as a general antiseptic in *cutaneous disorders*, whether organic or parasitic.

Allied Compounds.

Alumnol.—An almost colorless, non-hygroscopic powder; readily soluble in cold water or glycerin, less soluble in alcohol, and insoluble in ether. It is employed as a local remedy in solutions varying in strength from 1 to 50 per cent. Used externally. It is aluminium naphtholdisulphonate.

Asaprol.—A colorless, neutral crystalline powder, soluble in 1½ parts of water and 3 parts of alcohol.—*Dose*, 15–60 grains (1.0–4.0 Gm.). Beta-naphthol sodium sulphonate. It is prescribed as an antipyretic.

Benzonaphthol.—Obtained by the action of benzoic-chloride on beta-naphthol in a sand-bath. It is an odorless, tasteless, white, crystalline powder, or occurs in the form of long needles. Insoluble in cold water. *Dose*, 4–8 grains (0.18–0.5 Gm.).

Betol (*Naphtosalol—Salinaphthol*).—A substance analogous to salol, and prepared in the same manner, except that sodium-naphthol is used instead of sodium-phenol. It occurs as a colorless, odorless, tasteless, lustrous crystalline powder. Insoluble in water or glycerin, and with difficulty soluble in cold alcohol. *Dose*, 2-5 grains (0.12–0.3 Gm.).

Camphorated Naphthol.—Obtained by mixing 1 part of beta-naphthol with 2 parts of camphor. It is a brownish, transparent, syrupy liquid.

Hydronaphthol.—A derivative of beta-naphthol, obtained by the action of reducing agents. It occurs in scale-like crystals, of a silvery-white or grayish hue, of slightly aromatic odor and taste. Soluble in 1100 parts of water, and freely soluble in alcohol, ether, glycerin, benzene, chloroform, and fixed oils. *Dose*, 2–3 grains (0.12–0.18 Gm.).

ASAPROL, BETOL, and HYDRONAPHTHOL are best given in capsules, although betol, which is tasteless and insoluble in water, may be administered in the form of powders.

ALUMNOL.—An efficient remedy in many *acute* and *chronic inflammatory diseases of the skin*, and in *gonorrhea, chancres, syphilitic ulcers, balanitis*, etc. A 1 per cent. solution may be injected in gonorrhea, while stronger solutions (10–50 per cent.), or alumnol plaster, are recommended in *chronic diseases of the skin.*

ASAPROL.—Given for the same purposes as salicylic acid and the salicylates, although it is not so uniformly successful in *acute articular rheumatism*, while having the advantage of causing less heart-depression.

BETOL.—Used chiefly in the *bowel complaints of children*. It may be administered either by the mouth or through the rectum, associated with bismuth or antacids. It has been used also in *acute articular rheumatism* and *bladder affections*.

CAMPHORATED NAPHTHOL is considered by some practitioners to be superior to all other remedies to prevent suppuration in *acute tonsillitis*.

Fernet has employed it successfully in *tuberculous ulcerations of the tongue*, while Reboul, of Marseilles, and others have adopted it with good effect hypodermically in *tuberculous adenitis* and *tuberculosis of the testis*. It has also been used in *tuberculosis of the bladder*, *joints*, etc.

Ruault claims it to be an efficient local application to the turbinated bones in *ozena*.

HYDRONAPHTHOL.—Considered by many physicians to be superior to carbolic acid, since it is without disagreeable odor and can be used without exciting irritation or danger of toxic impression.

Dockrell employs it in the form of a plaster for destroying the trichophyton fungus of *tinea tonsurans*, and believes it to be superior to mercuric chloride as a germicide.

It has been used as a preventive of *dental caries*, and in the treatment of *gingivitis*, *pyorrhea alveolaris*, *diphtheria*, etc.

Internally it has been recommeuded in *dysentery*, *diarrhea*, *pulmonary tuberculosis*, and *typhoid fever*.

Contraindications.—These preparations should not be given internally when the functional activity of the kidneys is defective.

Administration.—NAPHTHALENE is best given internally in the form of pills or in capsules. When it is necessary to use it topically, the offensive odor of the drug may be disguised, it is said, by triturating it with a small quantity of the oil of bergamot. BETA-NAPHTHOL should be given in capsules, in the dose recommended, three times a day or oftener if necessary.

THE PHENOL ETHERS.

To this group belong creosote and its constituents. The most important of these phenol ethers are:

1. Anisol: Methylphenol ether, $C_6H_5OCH_3$.
2. Phenetol: Ethylphenol ether, $C_6H_5OC_2H_5$.
3. Guaiacol: Monomethyl ether of pyrocatechin, $C_6H_4OH.OCH_3$.
4. Creosol: Methylguaiacol, $C_6H_3CH_3OCH_3OH$.
5. Creosote: A mixture of varying composition of 60–90 per cent., guaiacol, creosol, methylcreosol, $C_6H_2.CH_3,CH_3,OCH_3,OH$, xylenol, $C_6H_3CH_3CH_3OH$, and phlorol, $C_6H_4C_2H_5OH$, and usually made of beechwood.

Creosotes of commerce from species of pine consist of much less guaiacol, more creosol, phenols, cresols, veratrol, and hydrocarbons. Pure beechwood creosote should not contain any phenols or cresols.

Creosōtum—Creosōti—Creosote. *U. S. P.*

Origin.—A mixture of phenols and phenol derivatives, chiefly guaiacol and creosol, obtained during the distillation of wood-tar, preferably that derived from the *Fagus silvatica* L. or *Fagus ferruginea* Ait. beech.

Description and Properties.—An almost colorless, yellowish or pinkish, highly refractive, oily liquid, having a penetrating smoky odor, and a burning, caustic taste; usually becoming darker in tint on exposure to light. Soluble in about 150 parts of water, but without forming a perfectly clear solution. With 120 parts of hot water it forms a clear liquid which on cooling becomes turbid, from the separation of minute oily drops. Soluble in all proportions in absolute alcohol, in ether, chloroform, benzin, carbon disulphide, acetic acid, and in fixed and volatile oils. Creosote is inflammable, burning with a luminous, smoky flame. It is neutral, or only faintly acid, to litmus-paper.

Dose.—1–5 minims (0.06–0.3 Cc.) [3 minims (0.2 Cc.), U. S. P.].

Official Preparations.

Aqua Creosoti—Aquæ Creosoti—Creosote Water.—*Dose*, 1–4 fluidrams (4.0–15.0 Cc.) [2 drams (8 Cc.), U. S. P.].

Incompatibles.—Strong sulphuric and nitric acids. It reduces silver salts, and explodes when combined with oxide of silver.

Synergists.—The same as for carbolic acid.

Physiological Action.—*Externally.*—It has an action similar to phenol.

Internally.—Its action upon the digestive, circulatory, nervous, and respiratory systems is practically the same as that of carbolic acid.

It does not stimulate the spinal cord so much as carbolic acid, and differs also from the latter drug in increasing the coagulability of the blood. Poisonous doses act like those of carbolic acid, but with more marked nervous symptoms.

Absorption and Elimination.—It is eliminated by the bronchial mucous membrane, and by the kidneys as guaiacol sulphate and creosol sulphate of potassium.

It is a stimulant expectorant.

It has the property when applied to meat of preserving it, whence its name (*creas*, flesh, *sohzote*, preserve).

Poisoning.—The symptoms and treatment of poisoning from creosote are the same as described under *Carbolic Acid.*

Therapeutics.—*Externally and Locally.*—Creosote is superior to carbolic acid as an antipruritic, although not so generally used as the latter, on account of its acrid and penetrating odor. It can be used externally for the same purposes as carbolic acid. It is a valuable hemostatic, and the creosote water may be used for this purpose.

Inhalations of creosote are recommended in *phthisis*, *chronic*

bronchitis, and *chronic congestion of the larynx* and *trachea*. It is a powerful local anesthetic, and is largely used by dentists and the laity for *aching teeth*. It is used to preserve dead animal matter for *dissection*, etc.

Internally.—Creosote can be used internally for the same purposes as carbolic acid, having the advantage over the latter drug in being one of the most efficient remedies in *pulmonary tuberculosis*. Probably no one remedy exerts so favorable an action upon the night sweats, cough, and expectoration as creosote, or guaiacol, which is preferred by many physicians. It is of less value in cases accompanied by high temperature and hemoptysis, and often aggravates these symptoms.

It must be remembered that many of the cases alleged to have been cured by creosote have been treated with cod-liver oil, tonics, and hygienic methods as well. Creosote undoubtedly limits the amount of secondary infections in phthisis and it is also stomachic. Many patients do badly with creosote and eminent phthisiologists deprecate its use.

Contraindications.—The same as for carbolic acid.

Administration.—Pure beechwood creosote alone should be used. It may be given in the form of creosote water, emulsion, or pills, or in capsules mixed with cod-liver oil. Capsules are the least offensive way of administration. Some persons prefer to take the drug in milk.

In the treatment of phthisis large doses are necessary. A tolerance can usually be established by gradually increasing doses. If the patient manifest any untoward symptoms, the drug must be reduced in quantity or discontinued altogether.

Guāiacol—Guaiacōlis—Guaiacol. *U. S. P.*

Definition.—One of the chief constituents of creosote; prepared either from beechwood tar, or synthetically.

Description and Properties.—Either a clear, colorless or light yellow, oily fluid, or colorless, prismatic crystals, which melt at 28.5° C. It has an agreeable aromatic odor.

Chemically it is the monomethyl ether of pyrocatechin (orthodihydroxy-benzene), $C_6H_4(OH)(OCH_3)$ 1 : 2.

Soluble in water (1 : 53), glycerin (1 : 1), and easily in alcohol. Being phenolic in character, it readily dissolves in caustic alkalies and forms salts with a large number of acids, one of which (the carbonate) has been made official. Of late years creosote has been largely superseded by guaiacol, upon which the value of creosote in large part depends.

Dose.—2–10 minims (0.12–0.6 Cc.) [8 minims (0.5 Cc.), U. S. P.].

The following derivatives have been introduced:

Guaiacolis Carbonas—Guaiacolis Carbonatis—Guaiacol Carbonate (U. S. P.).—*Definition.*—A guaiacol derivative $(C_6H_4(OCH_3)O)_2.CO$, obtained by the action of carbonyl chloride upon sodium-guaiacolate. Also known as *duotal*.

Description and Properties.—A white, crystalline, neutral powder, nearly odorless and tasteless. Insoluble in water; soluble in cold (1 : 48), more so in hot, alcohol; slightly soluble in glycerin and fatty oils.

Dose.—Average dose: 15 grains (1 Gm.), U. S. P.

Guaiacolis Benzoas—Guaiacolis Benzoatis—Guaiacol Benzoate (BENZOSOL).

—*Origin*, by heating on a water bath potassium guaiacol with benzosol-chloride: the impure benzosal-guaiacol formed is purified by recrystallization from alcohol.

Description and Properties.—Colorless, tasteless, and odorless crystalline powder, almost insoluble in water, but readily soluble in ether, chloroform, and hot alcohol.

Dose.—10–150 grains (0.60–10 Gm.) daily.

Guaiacolis Diiodidum—Guaiacolis Diiodidi—Guaiacol Diiodide.—*Origin*, by adding a solution of iodine in potassium iodide to an aqueous solution of sodium-guaiacol as long as precipitation continues.

Description and Properties.—Reddish-brown salt, having the odor of iodine, soluble in alcohol and fixed oils, and readily decomposed.

Dose.—2–15 grains (0.10–1 Gm.).

Guaiacolis Salicylas—Guaiacolis Salicylatis—Guaiacol Salicylate (GUAIACOL-SALOL).—*Origin*, by the action of phosphorous oxychloride on a mixture of sodium-guaiacol and salicylate. It is analogous to salol.

Description and Properties.—White, crystalline, odorless, and tasteless powder, insoluble in water, but soluble in alcohol, ether, and chloroform.

Dose.—10–150 grains (0.60–10 Gm.) daily.

Physiological Action of Guaiacol and its Derivatives.—GUAIACOL produces an action very similar to that of creosote. It is not caustic when applied in full strength. It possesses marked antipyretic properties. It is readily absorbed through the unbroken skin, and rapidly reduces febrile temperature when applied in this manner. The reduction of temperature lasts from four to six hours.

It is a diaphoretic and diuretic. It is excreted by the sweat, saliva, and urine, but is only slighly thrown out by the expired air, though small amounts of the drug have been found in the lung-tissue. As it is eliminated as a salt of ethyl-sulphuric acid, it must combine with albuminous bodies in the blood, and chiefly through the sulphur present in the albumin molecule. It can be found in the urine within fifteen minutes after administration or external application in the form of a substance giving the reaction of phenol.

It is more agreeable to the stomach than creosote, and frequently improves the appetite, though to some patients it is very disagreeable and acts as an irritant.

The GUAIACOL CARBONATE is usually much better borne by the stomach, and is therefore a useful and efficient substitute.

BENZOSOL, GUAIACOL BENZOATE, contains 54 per cent. of guaiacol. It is usually well borne by the patient, and seldom occasions any digestive disturbance. In the intestinal canal it resolves into guaiacol and benzoic acid, and is excreted by the urine as combinations of these substances.

Therapeutics.—GUAIACOL is used for the same purposes as creosote—less likely to irritate the intestinal canal and kidneys.

GUAIACOL causes a marked reduction of the temperature in cases of *tuberculous disease* when applied locally, nor is the antipyretic action when thus employed confined to tuberculous cases. It has given satisfactory results in other pyrexias. It is a very active antipyretic in *erysipelas*. The temperature begins to fall within fifteen or twenty minutes after the application of the drug. As with all antipyretics, the depressing action of guaiacol must be borne in mind.

Raymond first suggested the local application of guaiacol in *tonsillitis.* It undoubtedly exerts a favorable action on the disease.

Contraindications.—The same as for creosote.

Administration.—The solid derivatives of guaiacol may be given in powders or capsules. Guaiacol itself may be given in the same manner as creosote—preferably, mixed with cod-liver oil or enclosed in capsules.

Sōdii Phenolsulphōnas—Sōdii Phenolsulphonātis—Sodium Phenolsulphonate. *U. S. P.*

(Sodium Sulphocarbolate. U. S. P., 1900.)

Description and Properties.—Colorless, transparent, rhombic prisms, odorless, having a cooling, saline, slightly bitter taste. Somewhat efflorescent in dry air. Soluble in 4.8 parts of water, 132 parts of alcohol, 0.7 part of boiling water, and in 10 parts of boiling alcohol. The aqueous solution is neutral to litmus-paper. It should contain not less than 90 per cent. of pure sodium. Paraphenolsulphonate, $C_6H_4(OH)SO_4Na$).

Dose.—10–30 grains (0.60–2 Gm.) [4 grains (0.250 Gm.), U. S. P.].

Allied Compounds.

Potassii Sulphocarbolas—Potassii Sulphocarbolatis—Potassium Sulphocarbolate.

Calcii Sulphocarbolas—Calcii Sulphocarbolatis—Calcium Sulphocarbolate.

Magnesii Sulphocarbolas—Magnesii Sulphocarbolatis—Magnesium Sulphocarbolate.

Zinci Sulphocarbolas—Zincii Sulphocarbolatis—Zinc Sulphocarbolate.

All of the above have been employed, but the zinc sulphocarbolate is believed to be preferable to check diarrhea, and render the stools less foul. It is best given in pills, in doses of 2–3 grains (0.1–0.15 Gm.).

Physiological Action.—In medicinal doses SODIUM PHENOLSULPHONATE occasions no special symptoms, and in three or four times the medicinal dose it causes only slight lightness of the head.

It is changed in the system into carbolic acid and sodium sulphate, the latter being eliminated with the urine. The carbolic acid set free exerts its characteristic action and influence.

Therapeutics.—*Externally and Locally.*—In the strength of ½ dram (2.0 Gm.) to 8 ounces (237.0 Cc.) of water it forms a valuable gargle in *relaxed conditions of the throat.*

Solutions of different strengths have been used in *diphtheria, acute tonsillitis, aphthæ* of children, and *nasal catarrh.*

Thirty grains (2.0 Gm.) in 2 ounces (60.0 Cc.) each, of water, and hydrogen peroxide make an efficient injection in *gonorrhea.*

Internally.—It is a mild intestinal antiseptic, and may be used internally for the same purposes as carbolic acid in such disorders as *diarrhea, fermentative dyspepsia,* etc. It arrests the growth of *thrush,* and is considered by some physicians to exert a favorable action in *anginose scarlatina, diphtheria,* and *typhoid fever.* The ZINC SULPHOCARBOLATE is one of the best intestinal antiseptics to use in cases of *dyspeptic diarrhea* of children.

Administration.—Sodium phenolsulphonate is best given in solution.

Ichthyōlum—Ichthyōli—Ichthyol. (*Non-official.*)

Origin.—It is obtained by the destructive distillation of bituminous rock found near Seefeld in the Tyrolese Alps, which contains enormous quantities of semifossilized fishes and marine animals.

Description and Properties.—It occurs in the form of a brownish-yellow, transparent, oily liquid, containing about 10 per cent. of sulphur.

Upon being treated with concentrated sulphuric acid ichthyol is converted into ichthyol-sulphonic acid, which readily combines with ammonia and other alkalies, as well as with lithium, zinc, mercury, etc., forming the ammonium ichthyol, sodium ichthyol, zinc ichthyol, etc.

AMMONIUM ICHTHYOL occurs as a clear reddish-brown, syrupy liquid with a bituminous odor and taste. Soluble in water and in a mixture of equal volumes of ether and alcohol.

Dose.—2–10 minims (0.12–0.6 Cc.).

The other salts of ichthyol-sulphonic acid occur as brownish or black tar-like masses, the sodium salt being the most important, as it is the one most employed when ichthyol is desirable in pill form.

Dose.—Sodium ichthyol, 2–4 grains (0.1–0.25 Gm.).

Allied Drugs.

Thiolum—Thioli—Thiol.—*Origin.*—This substance is prepared by heating brown-colored paraffin or gas oils with sulphur, and extracting the sulphurated, unsaturated hydrocarbons with alcohol.

Description and Properties.—It occurs as a neutral, solid body, non-hygroscopic and soluble in water, and of a dark-brown color, or in the form of a dark reddish-brown, syrupy liquid, containing about 40 per cent. of thiol.

Dose.—½–1 grain (0.03–0.06 Gm.).

Tumenolum—Tumenoli—Tumenol.—*Origin.*—It is obtained from purified mineral oils by the direct action of concentrated sulphuric acid, without previous sulphuration, being a mixture of sulphones and sulphonic acids.

Description and Properties.—A dark-brown or blackish-brown liquid of a syrupy consistence.

Dose.—It is used only externally, in strengths of from 5 to 10 per cent.

Antagonists and Incompatibles.—Ichthyol possesses marked reducing properties, and should not therefore be combined with substances, like potassium permanganate, which part readily with oxygen.

Synergists.—Most members of this group, particularly the tars, carbolic acid, creosote, etc., aid its action.

Physiological Action.—*Externally and Locally.*—ICHTHYOL is ischemic, sedative, parasiticide, and possesses antiseptic and probably disinfectant, properties.

When applied to the skin in full strength it produces some irritation. It is readily absorbed, having the power to penetrate the skin, affecting the deeper tissues beneath.

Internally.—Digestive System.—Very large doses produce considerable gastro-intestinal irritation.

Circulatory System.—It has the power in medicinal doses of contracting the caliber of the arteries, and in large doses it increases the migration of the white blood-corpuscles.

The physiological action has not been fully studied, and it is

not yet positively known what action it has upon the nervous and respiratory systems and upon temperature.

Therapeutics.—*Externally and Locally.*—ICHTHYOL was introduced by Unna as a valuable remedy in certain diseases of the skin. It is particularly useful in *erythematous eczema*, *erysipelas*, *lupus erythematosus*, *irritable acne*, and certain forms of *acne rosacea*.

Agnew has employed it with advantage in *lymphatic enlargements*. It has also been found useful in *synovial inflammations*, *inflammatory conditions of the female genital organs*, and in certain diseases of the *ear* and *nose*.

THIOL, although inferior, is similar to ichthyol in its therapeutic action. It has been found to be valuable in the treatment of *herpes zoster*, *dermatitis herpetiformis*, and *erythema multiforme*.

Administration.—Ichthyol, when given internally, should be dispensed in capsules, while thiol may be given in capsules, pills, or wine.

Externally, ichthyol may be employed in solution, dissolved in chloroform or in a mixture of alcohol and ether, and applied with a brush; or in the form of an ointment mixed with soft petrolatum or lanolin in from 1–4 to 8 drams (4–15 Cc. to 32 Gm.). It is used also in the form of a soap in from 5 to 20 per cent. strength.

Thiol is used locally in powder form, or as an ointment of 5 to 10 per cent. of the liquid, or in collodion containing 5 per cent. of the powder, or in solutions of glycerin and aqueous solutions containing from 5 to 50 per cent. of the powder.

AROMATIC ACIDS.

These are characterized by their greatly reduced toxic action by means of the introduction of the acid radical, COOH. The most important are benzoic acid, C_6H_5COOH, and ortho-oxybenzoic acid or salicylic acid, $C_6H_4OH\ COOH$.

Benzoïnum—Benzoïni—Benzoin. *U. S. P.*

Origin.—A balsamic resin obtained from *Styrax Benzoin* Dryander and other unidentified species of *Styrax*. A large tree indigenous in Sumatra and Java, and probably in Cochin-China and Siam.

Description and Properties.—Benzoin exudes from incisions in the bark, and upon exposure to the air hardens into lumps consisting of agglutinated, yellowish-brown tears, which are internally milk-white, or in the form of a reddish-brown mass, more or less mottled from whitish tears imbedded in it. It is almost wholly soluble in 5 parts of moderately warm alcohol and in solutions of the fixed alkalies. When heated it gives off fumes of benzoic acid. It has an agreeable balsamic odor and a slight aromatic taste.

Benzoin is of the nature of a balsam, containing from 20 to 24 per cent. of *benzoic acid*, resin, and volatile oil. Some varieties contain cinnamic acid, which is undesirable, while the benzoin from Siam contains vanillin and possesses the odor of vanilla.

Dose.—Benzoin is rarely administered in substance. [15 grains (1 Gm.), U. S. P.].

Official Preparations.

Ădeps Benzoinătus—Ădipis Benzoinăti—Benzoinated Lard (2 per cent.).—For external use.

Tinctūra Benzoīni—Tinctūræ Benzoīni—Tincture of Benzoin (20 per cent.). *Dose*, 30 minims to 1 fluidram (2–4 Cc.) [15 minims (1 Cc.), U. S. P.].

Tinctūra Benzoīni Compŏsita—Tinctūræ Benzoīni Compŏsitæ—Compound Tincture of Benzoin.—Benzoin, 10; aloes, 2; storax, 8; tolu, 4; alcohol, q. s. parts. *Dose*, ½–2 fluidrams (2–8 Cc.) [30 minims (2 Cc.), U. S. P.].

Antagonists and Incompatibles.—The tincture and compound tincture are incompatible with aqueous preparations, the benzoins and other resins and balsams being precipitated from their alcoholic solutions by water.

Physiological Action.—The action of benzoin is due to the benzoic acid which it contains, and will therefore be considered under Benzoic Acid.

Ăcidum Benzōicum—Ăcidi Benzōici—Benzoic Acid. *U. S. P.*

Origin.—An organic acid, C_6H_5COOH, obtained from benzoin by sublimation, or prepared artificially.

Description and Properties.—White or yellowish-white, lustrous scales or friable scales, having a slight characteristic odor resembling that of benzoin, and of a warm acid taste; somewhat volatile at a moderately warm temperature, and rendered darker by exposure to light. Soluble, when pure, in about 281 parts of water, in 2 parts of alcohol at about 25° C. (77° F.), in 15 parts of boiling water, and in 1 part of boiling alcohol. It is also soluble in 3 parts of ether, 7 parts of chloroform, and readily soluble in carbon disulphide, in benzol, and in fixed and volatile oils. Sparingly soluble in benzin.

Benzoic acid has an acid reaction and is inflammable. It should be kept in dark amber-colored, well-stoppered bottles, in a cool place.

Dose.—5–15 grains (0.3–1 Gm.) [7½ grains (0.5 Gm.), U. S. P.].

Official Salts of Benzoic Acid.

Ammōnii Bĕnzoas—Ammōnii Benzoātis—Ammonium Benzoate (U. S. P.). —*Origin.*—Dissolve benzoic acid in water of ammonia and distilled water, evaporate, and crystallize. It should contain not less than 98 per cent. of pure ammonium benzoate, $C_6H_5.COONH_4$.

Description and Properties.—Thin, white, four-sided laminar crystals; odorless, or having a slight odor of benzoic acid; a saline, bitter, afterward slightly acrid taste, and gradually losing ammonia on exposure to air. Soluble, at 25° C. (77° F.), in 10.5 parts of water, in 25 parts of alcohol, in 1.2 parts of boiling water, and in 7.6 parts of boiling alcohol. The salt is neutral or has a very slight reaction upon litmus-paper. It should be kept in well-stoppered bottles.

Dose.—10–20 grains (0.6–1.2 Gm.) [15 grains (1 Gm.), U. S. P.].

Līthii Bĕnzoas—Līthii Benzoātis—Lithium Benzoate (U. S. P.).—*Origin.*—Prepared by decomposing lithium carbonate with benzoic acid. It should contain not less than 98.5 per cent. of pure lithium benzoate.

Description and Properties.—A light white powder, or small, shining, crystalline scales; odorless or of a faint, benzoin-like odor, and of a cooling, sweetish taste; permanent in the air. Soluble in 3 parts of water, in 13 parts of alcohol, and 2.5 parts of boiling water, and in 10 parts of boiling alcohol. The presence of sodium benzoate increases the solubility in water and lessens it in alcohol. The aqueous solution (1 : 20) of lithium benzoate has a faintly acid reaction upon litmus.

Dose.—5–20 grains (0.3–1.2 Gm.) [15 grains (1 Gm.), U. S. P.].

Sōdii Bĕnzoas—Sŏdii Benzoātis—Sodium Benzoate (U. S. P.).—*Origin.*—Prepared by decomposing sodium carbonate with benzoic acid. It should contain not less than 99 per cent. of pure sodium benzoate, $C_6H_5.COONa$.

Description and Properties.—A white amorphous powder, odorless or having a faint odor of benzoin, and a sweetish, astringent taste. Soluble in 1.6 parts of water, in 43

parts of alcohol at 25° C. (77° F.), in 1.3 parts of boiling water, and in 20 parts of boiling alcohol. The aqueous solution is neutral to litmus-paper. It is effervescent, and should be kept in well-stoppered bottles.

Dose.—5–30 grains (0.3–2 Gm.) [15 grains (1 Gm.), U. S. P.].

Allied and Unofficial Preparations.

Bismŭthi Bĕnzoas—Bismŭthi Benzoātis—Benzoate of Bismuth.

Mĕnthol Bĕnzoas—Mĕnthol Benzoātis—Benzoate of Menthol.—For external use.

Other benzoic combinations of interest are: *Benzanilid*, an antipyretic for children. *Dose*, 1–8 grains (0.1–0.5 Gm.). *Benzonaphthol*, analogous to betol, intestinal antiseptic in doses of 4–8 grains (0.25–0.5 Gm.). *Benzosol*, a guaiacol benzoate, used as an antiseptic and for the same general purposes as guaiacol. *Dose*, 4–8 grains (0.25–0.5 Gm.). Peronin, tropococaine, saccharin, orthoform, anesthesin, and β-eucaine are all benzoyl compounds.

Antagonists and Incompatibles.—BENZOIC ACID is incompatible with the alkaline salts, as those of sodium, etc., and AMMONIUM BENZOATE is incompatible with the ferric salts.

Physiological Action.—*Externally.*—When applied in a concentrated form to the skin or mucous membrane BENZOIC ACID is an irritant, and produces a catarrhal condition of the bronchial mucous membrane when its vapors are inhaled. It is a powerful antiseptic and germicide, preventing the growth of putrefactive bacteria in a solution of 1 : 1000.

Internally.—Digestive System.—In full medicinal doses BENZOIC ACID irritates the throat and produces a sense of heat in the epigastrium. Very large doses may occasion gastric inflammation with nausea and vomiting. The functional activity of the liver is stimulated by sodium benzoate.

Circulatory System.—In large doses BENZOIC ACID increases the pulse-rate to a marked extent, and is a stimulant to the entire circulatory apparatus. Slowing follows from vagus stimulation.

Nervous System.—There is evidence to show that benzoic acid quiets the higher cerebral centers.

Respiratory System.—It is a powerful stimulant in moderate medicinal doses, increasing the respiratory movements and promoting the bronchial secretion.

Absorption and Elimination.—It is eliminated chiefly by the kidneys, but also by the skin, salivary glands, and bronchopulmonary mucous membrane.

An important action of BENZOIC ACID is the change it undergoes in the body, being converted into hippuric acid, in combination with glycocoll. Some benzoic acid is eliminated unchanged, the hippuric acid formed renders alkaline urine acid, besides increasing the urinary flow and disinfecting and stimulating the genito-urinary tract. A copper-reducing body may also be found in the urine.

Temperature.—Like other members of this group, the acid, as well as its salts, possesses antipyretic properties, many observers holding it to be equal, if not superior, to salicylic acid in this respect. It is not yet known in what manner it reduces temperature.

Untoward Action.—BENZOIC ACID sometimes produces urticaria or an erythematous condition of the skin.

Therapeutics.—*Externally and Locally.*—The COMPOUND TINCTURE OF BENZOIN is an admirable preparation for many conditions requiring antiseptic, astringent, and stimulating dressing. It is frequently applied to *cutaneous wounds*, the alcohol evaporating and leaving upon the injured parts a protective film of balsams. A piece of lint or absorbent cotton saturated with the compound tincture has been used to close the punctures in the skin after tenotomy.

Stillé recommends a combination of the compound tincture of benzoin and glycerin for the treatment of *chapped hands* and *lips*, *frost-bite*, *fissured* and *chapped nipples*.

The compound tincture, diluted with water in various proportions, makes an efficient application in *catarrhal affections of the pharynx* and *larynx*, either in the beginning of an inflammation or during the relaxed condition which so often accompanies the termination of an acute attack. The *hoarseness* of vocalists and public speakers, the result of excessive strain upon the vocal cords, is frequently relieved by this remedy, particularly as inhaled with hot steam.

Inhalations of BENZOIN are a popular and frequently effective method of treating *acute catarrhal inflammation* of the upper respiratory passages.

The *cough* and *expectoration* of *chronic bronchitis* and *chronic phthisis* are eased and lessened by inhaling night and morning 1 dram (4 Gm.) of BENZOIC ACID, added to boiling water.

A preparation like the following is an efficient and agreeable lotion for irritative forms of *chronic nasal catarrh*:

℞. Sodii boratis,	℥ij	(60.0 Gm.);
Acidi benzoici,	gr. x	(0.6 Gm.).
M. et fiat pulvis No. 1,		

Sig. To half a tumblerful of water add half a teaspoonful each of the powder and glycerin. Use freely as a lotion.

The simple TINCTURE OF BENZOIN is an excellent application to *spongy gums*. There is much evidence of the efficiency of BISMUTH BENZOATE as a dressing for chronic or sloughing *ulcers*. *Specific sores*, *chancroids* and *chancres* especially, are well treated by dusting the parts with the benzoate after throughly bathing the surface with a weak solution of bichloride of mercury.

Probably the most important therapeutic action of BENZOIC ACID is shown in the treatment of *cystitis* and *pyelitis*, which are complicated with decomposing and alkaline urine.

Phosphatic *calculi* may be dissolved by the prolonged administration of AMMONIUM BENZOATE, which is preferable to benzoic acid for this purpose. *Incontinence of urine*, if due simply to the alkalinity of the urine, is relieved by the same remedy.

Liégeois has employed SODIUM BENZOATE as a *cholagogue* with

excellent results. He associates it with rhubarb. He also states that benzoate of sodium favorably modifies the pain of *pharyngitis.* Sodium benzoate is an excellent substitute for sodium salicylate, being especially useful in the *septic diseases.* It is equally powerful as an antiseptic and antipyretic, though slower in its action than sodium salicylate. Its effects, however, are more permanent and innocuous.

Administration.—Benzoic acid is best administered in pill form or in capsules, with balsam of fir or Castile soap as an excipient. The soluble benzoates may be given in solution in some aromatic water or in compressed pills. The solution, however, is preferable, and the unpleasant taste may be well disguised by a little spirit of chloroform. When any of these preparations are given for their action upon the urinary tract, it may sometimes be advantageous to combine them with a urinary sedative, such as tincture of belladonna or hyoscyamus.

Ăcidum Salicȳlicum—Ăcidi Salicȳlici—Salicylic Acid. *U. S. P.*

Origin.—A monobasic organic acid ($C_6H_4(OH)COOH$ 1 : 2) existing naturally in combination in various plants [like *Spiræa ulmaria* (meadow-sweet), *Gaultheria procumbens* (wintergreen), etc.], but chiefly prepared synthetically by combining the elements of pure carbolic acid with dry carbonic acid and purifying.

Description and Properties.—Light, fine, white prismatic needles, or a light white crystalline powder, odorless, having a sweetish, afterward acrid taste; permanent in the air. It is soluble in about 308 parts of water, in 2 parts of alcohol at 25° C. (77° F.), and in 14 parts of boiling water. The addition of 2 parts of sodium sulphite or 1 part of ammonium phosphate renders it much more soluble in water.

Test.—The addition of ferric chloride to a saturated solution produces a fine bluish-violet color.

Dose.—3–60 grains (0.25–4.0 Gm.) [7.5 grains (0.5 Gm.), U. S. P.].

Official Salts.

Lithii Salicylas—Lithii Salicylatis—Lithium Salicylate (U. S. P.).—*Origin.*—Obtained by heating salicylic acid, lithium carbonate, and water until effervescence ceases, filtering, and evaporating. It should not contain less than 98.5 per cent. of pure lithium salicylate ($C_6H_4(OH)COOLi$).

Description and Properties.—A white or grayish-white powder, odorless, having a sweetish taste, deliquescent on exposure to air, very soluble in water and alcohol.

Dose.—5–60 grains (0.3–4.0 Gm.) [15 grains (1 Gm.), U. S. P.].

Sodii Salicylas—Sodii Salicylatis—Sodium Salicylate (U. S. P.).—*Origin.*—Prepared by acting on sodium carbonate with salicylic acid, straining, and heating the solution. It should contain not less than 99.5 per cent. of pure sodium salicylate ($C_6H_4(OH)COONa$).

Description and Properties.—A white amorphous powder, odorless, sweetish, saline taste, permanent in air, soluble in 0.8 part of water, in 5.5 parts of alcohol at 25° C. (77° F.), and in glycerine.

Dose.—5.60 grains (0.3–4.0 Gm.) [15 grains (1 Gm.), U. S. P.].

Ammonii Salicylas—Ammonii Salicylatis—Ammonium Salicylate (U. S. P.).—*Definition.*—It should contain not less than 98 per cent. of pure ammonium salicylate ($C_6H_4(OH)COONH_4$).

Description and Properties.—It occurs in colorless, lustrous, monoclinic prisms or plates, or white crystalline powder, odorless, and having at first a slightly saline, bitter taste, with a sweetish after taste. Permanent in dry air. The concentrated aqueous solution reddens blue litmus. Very soluble in water (0.9 part), slightly less so in alcohol (2.3 parts).

Dose.—Average dose 4 grains (0.250 Gm. = 250 milligrammes), U. S. P.

Physiological Action.—*Externally and Locally.*—Salicylic acid is antiseptic, parasiticide, irritant to mucous membranes; possesses the power to soften the epidermis; checks perspiration when locally applied (anhydrotic).

Internally.—Digestive System.—Small doses stimulate the stomach; larger doses act as an irritant. It retards proteolysis and also hinders fermentation, and putrefaction in the gastro-enteric canal. The biliary secretion is somewhat increased, particularly as to its solids. The liver secretory cells are in some manner stimulated.

Circulatory System.—Small doses of salicylic acid have no very appreciable effect upon the circulation. Full medicinal doses first cause the heart to beat faster and stronger, increasing arterial tension; later the arterial pressure is lowered, and excessive or toxic doses cause the pulse to become slow and labored. Its tendency ultimately, even in medicinal doses, is to depress, rather than stimulate, the heart. Its effect upon the blood is to restrain the migration of the white corpuscles.

Nervous System.—In small doses it has no cerebral action. In large doses, and in some susceptible persons in full medicinal doses, salicylic acid causes cerebral congestion, indicated by a feeling of tension in the cerebrum, headache, confusion of thought, tinnitus aurium, vertigo, and sometimes delirium. Toxic doses may occasionally produce cerebral convulsions. It lessens the reflexes, but does not affect the motor peripheral nerves. Slight analgesia may be produced.

Absorption.—Salicylic acid is converted by the gastro-intestinal secretions into the sodium salicylate, in which form it enters into the circulation.

Respiratory System.—Small doses stimulate the respiratory center and the pulmonary vagi, making the respiration quicker and deeper. Toxic doses paralyze the center and vagi, causing slow and labored respiration and death from asphyxia.

Temperature.—Febrile temperature is markedly reduced by large doses of salicylic acid. The reduction takes place usually within half an hour after a dose has been taken, and lasts several hours.

Elimination.—It increases the urinary flow as a direct parenchyma stimulant. It appears in the urine as salicyluric acid.

It is a powerful diaphoretic, large doses often causing exhausting sweating. It also increases the secretion of milk and the amount of sugar in that secretion.

Elimination takes place rapidly by all the emunctories (nine minutes in the urine), but chiefly through the kidneys and skin. Traces of salicylic acid may be found for a long time after the administration of a single dose, ten to fifteen days, three days is the average. Metabolism is markedly affected, the sulphates and nitrogen in the urine going up 10 per cent. under its use. Uric acid is particularly increased. What the mechanism is is not yet determined.

Untoward Action.—Erythema, urticaria, or petechiæ, accompanied by intense itching, occasionally edema of the eyelids and

lower extremities, mental depression, muscular weakness, motor disturbances, sweating, and buzzing in the ears, as mentioned under Poisoning, but to a less degree. Occasionally bleeding is seen. Abortion may be induced by its use. Prolonged administration may also produce anemia.

Poisoning.—There are roaring in the ears, deafness, intense headache, vertigo, and possibly delirium, profuse and exhausting sweating, subnormal temperature, very weak, compressible pulse, feeble and shallow respirations, dimness of vision, ptosis, and often strabismus. Albumin or blood or hemoglobin may be found in the urine. The urine and feces pass involuntarily. Death usually results from respiratory failure, but is extremely rare; 15 Gm. of sodium salicylate has caused severe symptoms, but recovery has followed.

Treatment of Poisoning.—Diffusible stimulants, atropine, strychnine—the same treatment as in poisoning by acetanilid.

Therapeutics.—*Externally and Locally.*—SALICYLIC ACID has been satisfactorily employed, in the strength of ½ to 1 dram in 1 ounce (2–4 in 32 Gm.) of petrolatum, in the treatment of *erysipelas.*

In the treatment of *chancroid* salicylic acid has been extensively employed. The powdered acid should be thoroughly dusted over the surface.

The peculiar action of salicylic acid in softening and loosening thickened masses of epidermis and favoring the normal proliferation of epithelium renders the drug especially useful in the treatment of *indurated eczema,* particularly of the palm and sole, *verruca, tylosis, callositas, corns, warts,* etc.

It is one of the most useful drugs in the treatment of forms of *eczema, impetigo contagiosa, psoriasis, lupus, parasitic affections,* and in *non-parasitic sycosis.* It has been used successfully in the treatment of *acne, comedones,* and *pruritus.* A 3 per cent. solution has been recommended in *aspergillus* of the outer auditory meatus. A wash, 3 grains to 1 ounce (0.2 to 30 Cc.) is efficient in *otorrhea.* Solutions of varying strengths are frequently useful in *acute coryza, diphtheria, inflammation of fauces, catarrhal stomatitis,* and to correct *offensive expectoration,* especially in *phthisis* and *gangrene of the lung.*

Internally.—There is no better example of empiricism in therapeutics than the employment of SALICYLIC ACID in *acute articular rheumatism.* Used at first in this disease to reduce temperature, it was found that while it exerted marked antipyretic action, it also lessened the pain and swelling, and in the majority of cases shortened the duration of the disease. It cannot be classed as a "specific" in any sense of the word, but merely relieves certain symptoms—fever, pain, and swelling. Other symptoms—or complications, according to some authors—such as heart affections, are uninfluenced by this medicine. It has no power to prevent either affections of the heart or relapses.

Rheumatic tetanus, *iridochoroiditis*, and *sclerotitis* are alleged to have been cured by this drug. It is useful in *gout* to relieve pain, but does not seem to influence the disease, and is of no particular value in *chronic* or *gonorrheal rheumatism*, *rheumatic arthritis*, or *rheumatic hyperpyrexia*.

It is credited with being quite efficient in *chorea* of rheumatic origin, and in relieving the pains of *herpes zoster* and *neuralgic headache*.

It is a drug to be tried in many diseases of rheumatic or neuralgic character, unless some distinct contraindication to its use exists. It surpasses any drug, with the possible exception of guaiac, in the treatment of *quinsy*, and particularly *infectious tonsillitis*. The medicine is highly regarded by competent advocates as a remedy in *diphtheria*. *Lumbago* often yields to its influence, and it has also been recommended in *sciatica*, which in the very mild cases is helped somewhat.

It is a useful antizymotic to prevent *putrefactive fermentation* and *flatulence*, and lessen thereby the tendency to *crapulous diarrhea*. It is of service in some cases of diabetes.

It has been found of use in *influenza*, and is an efficient antiseptic remedy in *chronic gastric catarrh*, *diarrhea*, *cholera*, and *enterocolitis*. By some eminent clinicians it is considered to be one of the most effectual remedies in *pleurisy* with effusion.

It has been recommended as an effectual anthelmintic, both for *tape-* and *round-worms*.

Contraindications.—Salicylic acid should not be given in large doses to persons who have a weak heart or are otherwise greatly debilitated, at least not without counteracting its toxic tendencies with nutrients and diffusible stimulants.

Administration.—Owing to its irritant action upon the mucous membrane, it is best given in a solution of glycerin and some aromatic water, after meals. So concentrated a form as a pill or capsule is not recommended.

Many of the untoward cerebral effects may be relieved by giving 20 grains (1.3 Gm.) of sodium or potassium bromide.

If any benefit is to be derived from salicylic acid in acute articular rheumatism, it must be used early in the disease and in heroic doses at comparatively frequent intervals—not less than 20 grains (1.3 Gm.) every two, three, or four hours for an adult. If too serious gastric and cerebral symptoms manifest themselves, the drug may be decreased in amount or discontinued until the unpleasant action subsides. It is better, except in acute articular rheumatism, to give a small dose, repeated frequently, than to administer a full dose at once.

The physiological action and therapeutics of LITHIUM SALICYLATE are practically the same as those of salicylic acid or sodium salicylate. It is, however, richer in salicylic acid than the sodium salt, and in *gout* and *chronic rheumatism* has been thought to be of more value than salicylic acid. It should be given in solution.

SODIUM SALICYLATE is identical in physiological action and uses with salicylic acid, with the exception that it is less irritating to the stomach, and is therefore ordinarily to be preferred to the acid.

It may be prescribed in aromatic water, in syrup, or in powder, pills, or capsules.

Phenylis Salicylas—Phenylis Salicylātis—Phenyl Salicylate. *U. S. P.*

(SALOL, U. S. P., 1890.)

Origin.—The salicylic ether ($C_6H_4(OH)COOC_6H_5$ 1 : 2) of phenyl prepared by heating salicylic acid with phenol in the presence of phosphorus pentachloride.

Description and Properties.—A white, crystalline powder, odorless, or having a faintly aromatic odor, and almost tasteless. Permanent in the air. Almost soluble in 2333 parts of water; soluble in 15 parts of alcohol at 25° C. (77° F.); also in 0.3 part of ether, and readily in chloroform and in fixed or volatile oils.

Dose.—3–15 grains (0.19–1.0 Gm.), [7½ grains (0.5 Gm.) U. S. P.].

Physiological Action.—*Externally and Locally.*—It is a more powerful antiseptic than either of its constituents. Nencki claims that it is not a germicide, as it will not destroy bacteria when present, although it prevents their formatfon. It is not, like salicylic acid, irritating to the mucous membranes.

Internally.—It is converted by the pancreatic and intestinal juices into its original constituents—salicylic acid and carbolic acid. It is usually absorbed and eliminated very rapidly, having been detected in the urine in the form of salicyluric acid and phenol-ether-sulphuric acid within thirty minutes after its ingestion by the stomach. To the latter acid is due the dark, smoky color of the urine which sometimes exists under large or continued doses of salol.

The action of salol is essentially like that of its constituents, but it is a more powerful antipyretic, analgesic, and cerebrospinal sedative. It reduces temperature much more promptly, the antipyretic action occurring within fifteen minutes after a full medicinal dose has been taken. The effect, however, is not prolonged, repeated doses being required to maintain the reduction of temperature.

The circulation is, perhaps, not so much depressed as by salicylic acid. The respirations are at first quite rapidly increased, and are rendered very shallow, requiring some time to resume their normal condition. Large doses may cause phenol-poisoning.

Therapeutics.—*Externally and Locally.*—Salol is especially recommended as an antiseptic dressing for *wounds*, *burns*, *venereal ulcers*, and *buboes*. Powdered salol or an ointment—1 part to 150 parts of petrolatum—has been used in cases of *tubercular laryngitis* and *ozena*. Like salicylic acid, it is also of value in *eczema* and *sycosis simplex*.

Internally.—It is an efficient remedy in all diseases benefited by the internal administration of salicylic acid. In addition to these services it is a valuable remedy in *acute* and *chronic cystitis*, *gonor-*

rhea, *intestinal catarrh*, especially *duodenal catarrh* and *catarrhal jaundice*, and to relieve the pains of *neuritis* and *myalgia*.

Administration.—It may be given in pills, capsules, powders, emulsion, or suspended in milk. The compressed tablets of this drug so extensively used at present are not to be recommended, owing to their slow and difficult solution.

Allied Compounds.

The compounds of salicylic acid are extremely numerous. It is beyond the purpose of the present volume to mention them all, but the following have been employed widely and have something in their favor as remedial agents: *Aspirin*, or acetyl-salicylic acid, a white powder soluble in 100 parts of water, said to be more efficient than the salicylates, and to cause less gastric irritation. *Dose*, 5–15 grains (0.3–1 Gm.), thrice daily. *Salacetol*, resembling salol, an acetone radicle replacing the phenyl in that compound. Used for the same purposes in doses of 30–45 grains (2–5 Gm.). *Salicylamid* is tasteless, more soluble than salicylic acid, and more active. *Dose*, 2–5 grains (0.1–0.3 Gm.). *Salifebrin*, acetanilid and salicylic acid; not reliable. *Saligenin*, a substitute for salicin in doses of 8–15 grains (0.5–1 Gm.). *Salipyrine*, antipyrine and salicylic acid, has the combined effects of its constituents, and is an efficient drug in doses of 15–30 grains (1–2 Gm.). *Salophen*, resembling salol somewhat, but phenol in different form, acetyl *p*-amidophenol. *Dose*, 12–30 grains (1–2 Gm.).

It should be recalled that practically all of these derivatives are decomposed to salicylic acid and to sodium salicylate.

Salicīnum—Salicīni—Salicin. *U. S. P.*

Origin.—A glycosid obtained from several species of *Salix* (willow) and *Populus* (poplar).

Description and Properties.—Colorless or white, silky, shining, crystalline needles, or a crystalline powder, odorless and having a very bitter taste. Permanent in the air. Soluble in 21 parts of water, 71 parts of alcohol at 25° C. (77° F.), 0.7 part of boiling water, and in 2 parts of boiling alcohol.

Dose.—10 grains–2 drams (0.6–8.0 Gm.) [15 grains (1 Gm.), U. S. P.].

Physiological Action.—Its physiological effect is analogous to that of salicylic acid, but is much less active than the latter. It does not disturb digestion, but in moderate doses promotes appetite and acts like other bitters. It is more rapidly absorbed than salicylic acid, is partly decomposed, and is found in the urine, as salicin and salicylic acid, in from fifteen to thirty minutes after the ingestion of a single dose.

Therapeutics.—While inferior to salicylic acid in most respects, salicin is frequently used for the same purposes.

Administration.—Salicin may be administered in powders, capsules, or solution. Owing, however, to its bulk and intensely bitter taste, it is perhaps best given in suspension in the aromatic elixir of licorice or in syrup of yerba santa.

Ōleum Gaulthēriæ—Ōlei Gaulthēriæ—Oil of Wintergreen. *U. S. P.*

Origin.—A volatile oil distilled from the leaves of *Gaultheria procumbens* L., a small evergreen plant indigenous in the northern hemisphere and bearing a scarlet, fleshy, berry-like fruit.

Description and Properties.—The volatile oil is a colorless or yellow, or occasionally reddish, liquid, having a characteristic, strongly aromatic odor, and a sweetish, warm, and aromatic taste. Specific gravity, 1.172 to 1.180 at 25° C. (77° F.).

It consists almost entirely of methyl salicylate. It should be kept in well-stoppered bottles, protected from light.

Dose.— 2–10 minims (0.12–0.6 Cc.) [15 minims (1 Cc.), U. S. P.].

Official Preparation.

Spiritus Gaultheriæ—Spiritus Gaultheriæ—Spirit of Gaultheria (ESSENCE OF WINTERGREEN).—*Dose,* 1–2 fluidrams (4.0–8.0 Cc.) [30 minims (2 Cc.), U. S. P.].

Physiological Action.—*Externally and Locally.*—Oil of wintergreen is a stimulant and a powerful antiseptic.

Internally.—Its action is identical with that of salicylic acid and its salts.

Therapeutics.—*Externally and Locally.*—Used for the same purposes as the aromatic oils, and also locally applied in the treatment of acute articular rheumatism.

Internally.—Used for the same purposes as salicylic acid.

Mĕthylis Salicȳlas—Mĕthylis Salicylātis—Methyl Salicylate. *U. S. P.*

Definition.—An ester ($C_6H_4(OH)COOCH_3$ 1 : 3) produced synthetically. It is the principal constituent of oil of gaultheria and oil of betula.

Dose.—15 minims (1 Cc.), U. S. P.

Ōleum Betūlæ—Ōlei Betūlæ—Oil of Birch. *U. S. P.*

Definition.—A volatile oil obtained by maceration and distillation from the bark of the sweet birch, *Betula lenta* L.

Dose.—15 minims (1 Cc.), U. S. P.

Allied Compounds.

Aspirin, acetyl salicylic acid, is decomposed in salicylic acid in the intestines, and hence has no marked advantage. Its taste is less offensive and hence it can be taken by patients who have irritable stomachs. 30–45 grains (2–3 Gm.).

Mesotan is a methyloxymethyl ester of salicylic acid. It is a liquid and resembles oil of wintergreen without its agreeable (?) odor. It is readily absorbed by the skin and is thought to influence the joints more promptly than the oil of wintergreen. It is of value in lumbago also, and may be combined with olive oil and massage in some of the more protracted arthritides. It has the same indications as the other salicylates, and taken internally is ultimately broken down into sodium salicylate.

Līquor Formaldehȳdi—Liquōris Formaldehȳdi—Solution of Formaldehyde. *U. S. P.*

Definition.—An aqueous solution containing not less than 37 per cent. by weight of absolute formaldehyde, H.COH.

Properties.—Formaldehyde itself is a gas at ordinary temperatures, having a very pungent odor. The various products on the market are solutions of the gas in water. They are variously known as *formalin*, *formol*, *methylaldehyde*, *oxymethylene*, *methanal*, etc. Formaldehyde readily undergoes polymerization, whereby a solid form is obtained, known as paraformaldehyde, or *paraform*. When a solution of formaldehyde is evaporated by heat, and more slowly by long standing, paraformaldehyde separates as a white, flocculent, nearly odorless mass, which is almost insoluble in

water, alcohol, or ether, and which begins to sublime below 100° C. When heated, paraformaldehyde vaporizes and reforms the gaseous formaldehyde. It is sold in tablets which are employed for disinfecting purposes by vaporization.

Formaldehyde is very active chemically; it has a strong reducing action and unites with ammonia, forming the official odorless hexamethylenamine (urotropine). It is easily oxidized.

Several dusting-powders containing formaldehyde in combination have been introduced; thus *glutol* is a compound of gelatin and formaldehyde, *amyloform*, of starch and formaldehyde, etc.

Formaldehyde is a constituent of many food-preservatives, embalming preparations, etc.

Therapeutics.—Formaldehyde solutions are efficient and valuable bactericides. They are used very extensively in mouth-washes, etc. The vapor and liquid are very irritating and are not well adapted to internal medication.

Bălsamum Peruviānum—Bălsami Peruviāni—Balsam of Peru. *U. S. P.*

Origin.—A balsam obtained from *Toluifera Pareiræ* (Royale) Baillon, a tree growing in Brazil and near the west coast of South America.

Description and Properties.—A liquid having a syrupy consistence, free from stringency or stickiness, of a brownish-black color in bulk, reddish brown and transparent in thin layers, of an agreeable, vanilla-like, somewhat smoky odor, and a bitter tase, leaving a persistent after-taste. On exposure to air it does not become hard. It is completely soluble in 5 parts of alcohol.

The drug contains, among other substances, benzoic and cinnamic acid, cinnamein about 60 per cent., and resin 32 per cent.

Dose.—8–30 minims (0.5–1.84 Cc.) [15 grains (1 Gm.), U. S. P.].

Physiological Action.—Its physiological action is largely due to the aromatic acids, cinnamic, and benzoic acids contained. See Benzoin.

Therapeutics.—In various cutaneous disorders balsam of Peru is very efficient, being employed in *pruritus vulvæ*, *eczema*, *scabies*, *ringworm*, etc. It is remarkably efficacious as an application to *cracked nipples*, *cracked lips*, *indolent sores*, *bed-sores*, etc., and is also serviceable in certain diseased conditions of the nose and throat, such as *atrophic rhinitis* and *tonsillar diphtheria*.

As a stimulant expectorant the drug is efficient in *chronic bronchitis*, being regarded by some physicians as of great service in *phthisis pulmonalis*.—Like myrrh, balsam of Peru has been used to some extent as a stomachic carminative and tonic.

Administration.—It is best given in an emulsion or in glycerin.

VOLATILE OILS, RESINS, OLEORESINS, BALSAMS.

THE following-named drugs, classed by some authors as aromatics, are not only active antiseptics and antispasmodics, but possess properties very similar to those of the more typical antiseptics, antipyretics, and anesthetics. These antiseptic properties of aromatic drugs are well known to modern science, and, what is of unique interest and significance, were perfectly familiar to the ancients, who could not possibly divine the scientific value of the virtues familiarized only by the crudest empiricism. In the custom of the Egyptians of embalming the dead we have a remarkable example of their divination of antisepsis in the perfumes and spices in which their dead were buried; and in the Christian Gospel we read of Nicodemus that he "brought a mixture of myrrh and aloes," and that "they took the body of Jesus, and wound it in linen cloths with the spices, as the manner of the Jews is to bury" (John xix. 39, 40).

Aromatics owe their virtues chiefly to the volatile oils they contain, which usually possess the characteristic odor and taste of the plants from which they are derived. These volatile oils are very numerous and extremely complex in their chemical structure, yet most have certain general features in common. The most widely distributed chemical constituents are *terpenes*, hydrocarbons of the aromatic series $(C_5H_8)_n$. Many of them contain, in addition, phenols, aldehydes, ketones, alcohols, acids, esters, lactones, and oxides—a few contain nitrogen or sulphur, in which case their action is the more complex.

The chemical investigation of many of these oils has but just begun, and it is not improbable that in the isolation and purification of some of their constituents valuable therapeutic agents may be added to the physician's armamentarium. As they agree in their physiological action, in large part at least, the general effects are here summarized in brief. It should be remembered that many of these volatile oils are very widely employed in alcoholic liquors—*crême de mênthe*, *curaçoa*, *maraschino*, *absinthe*, *kümmel*, *chartreuse*, etc., and therein add their effects to those of the alcohol.

General Action.—Locally, the volatile oils are stimulant and irritant. Internally, when taken in moderate quantities, they stimulate the digestive organs, and increase the activity of the circula-

tion reflexly by stimulating the sensory ends of the vagus distributed to the mucous membrane of the stomach. The impression is conveyed to the center in the medulla, and from there transmitted to the accelerator nerves of the heart. Very large doses depress the heart's action, arresting it in diastole. The poisonous action of aromatics is similar to that of irritant-narcotic poisons. The different oils will vary considerably according to the predominant constituent. Thus the purer terpenes containing oils are much less poisonous; while those containing phenols, as eugenol, thymol, etc., give the characteristic picture of carbolic acid poisoning. Most of them irritate the kidneys. Many of them are quite powerful local anesthetics, particularly if rich in ketones or phenols. They first stimulate, and then depress and exhaust, the nervous system. In diseased conditions they are used to increase peristalsis, to impart tone to the stomach, and to act as antiseptics; to arrest gastric and intestinal fermentation; to relieve pain wherever they are applied; and, by increasing the circulation in the brain and improving the condition of the gastro-intestinal tract, to relieve many of the phenomena of hysteria. The chief contraindication for the internal use of these drugs is the inflammation of the stomach, intestines, and kidneys.

The volatile oils and the various preparations of the aromatics should be given diluted in some proper vehicle.

A classification of this general group is not feasible. The individual members are so complex that a purely chemical classification, based on their many constituents, would be impractical. From the purely physical standpoint they may be divided into a few broad groups, as volatile oils, resins, oleoresins, gumresins and balsams, but this offers no clue to their therapeutic applications. The definitions of these groups may be found in another place in this book. The general grouping arrangement by many of the older writers on materia medica commends itself as practical, and the following series will be taken up: (1) Aromatic flavoring vehicles and carminatives, including mentha, coriandrum, anthemus, matricaria, anisum, marrubium, rosa, aurantium, caryophyllus, cardamomum, cinnamomum, fœniculum, myristica, carum, and a number of others; (2) condiments: piper, capsicum, zingiber, macis, etc.; (3) stimulants to the respiratory and genito-urinary mucous membranes; (4) volatile oils used as nervous stimulants; and (5) skin irritants and counterirritants, including turpentine and its allies, mustard and cantharides.

It should be borne in mind, in view of their composition, that any or all of them may be used as antiseptics, and, further, that some members of the group may be classed in any or all of the groups mentioned. Thus capsicum is a good counterirritant, an excellent aromatic carminative, a widely employed condiment, and may be of service in the late period of a chronic cystitis; others might be instanced. Thus the classification is purely convenient—it possesses no other value.

I. AROMATIC VEHICLES AND CARMINATIVES.

Anīsum—Anīsi—Anise. *U. S. P.*

Origin.—The ripe fruit of *Pimpinella Anisum* L., a plant indigenous in Western Asia and Egypt, and extensively cultivated in Europe.

Description and Properties.—About ⅛–¼ inch (3–6 Mm.) long, ovate compressed laterally, grayish, finely pubescent, consisting of two mericarps, each with a flat face, and five light-brownish filiform ridges, and about fifteen thin oil-tubes, perceptible in transverse section by the aid of the microscope. Anise has an agreeable, aromatic odor and a sweet, spicy taste. It contains from 1½ to 3 per cent. of a volatile oil. It resembles the fruit of the conium, differing from it usually in being longer and more ovate, and having another odor and taste. The fruit of the conium has, moreover, but a single smooth mericarp without oil-tubes.

Dose.—8–30 grains (0.5–2.0 Gm.) [7½ grains (0.5 Gm.), U. S. P.].

Ōleum Anīsi—Ōlei Anīsi—Oil of Anise. *U. S. P.*

Origin.—A volatile oil distilled from anise or from the fruit of Star anise, *Illicium verum*.

Description and Properties.—A colorless or pale-yellow, thin and strongly refractive liquid, having the characteristic odor of anise, and a sweetish, mildly aromatic taste; neutral in reaction. It contains a stearopten *anethol*, $C_{10}H_{12}O$, and a methyl chavicol, $C_{10}H_{12}O$, upon which its properties in large part depend.

Oil of anise should be kept in well-stoppered bottles, protected from light, and if it has separated into a liquid and a solid portion, it should be completely liquefied by warming before being dispensed.

Dose.—1–5 minims (0.06–0.3 Cc.) [3 minims (0.2 Cc.), U. S. P.].

Official Preparations.

Āqua Anīsi—Āquæ Anīsi—Anise Water.—*Dose*, ¼–1 fluidounce (8.0–30.0 Cc.) [2 drams (16 Cc.), U. S. P.].

Spĭritus Anīsi—Spĭritus Anīsi—Spirit of Anise.—*Dose*, 1–2 fluidrams (4.0–8.0 Cc.) [1 dram (4 Cc.), U. S. P.].

Oil of anise is contained in the following preparations:

Spĭritus Aurăntii Compŏsitus; Syrŭpus Sarsaparĭllæ Compŏsitus; Tinctūra Opii Camphorăta; Trochīsci Glycyrrhīzæ et Ōpii.

Physiological Action.—Anise is slightly antiseptic, stimulant, and carminative; oil of anise is irritant if applied in full strength to mucous membranes, stimulating both the digestive and circulatory apparatus, improving the appetite, and slightly strengthening and accelerating the heart's action. In very large doses it possesses mildly narcotic properties. It is excreted in the urine, sweat, and by the bronchial mucous membrane, the secretion from which it liquefies.

Therapeutics.—Anise is employed to relieve flatulence in children, as a sedative expectorant, and as a vehicle to flavor medicines.

Cinnamōmum—Cinnamōmi—Cinnamon. *U. S. P.*

Origin.—There are two official varieties of cinnamon: 1, the inner bark of the shoots of *Cinnamomum zeylanicum* Breyne, a tree about 30 feet high (9 M.), found in the forests of Ceylon (Ceylon cinnamon); 2, the bark of an undetermined species of *Cinnamomum* known as *Cinnamomum saigonicum* (Saigon cinnamon, Saigon cassia), from Saigon, the capital of French Cochin-China, where it is collected and exported.

Description and Properties.—Most of the article brought to the United States is the cassia cinnamon. The varieties differ somewhat in appearance, and are found in the shops as quills of varying lengths, about $\frac{1}{25}$ inch (1 Mm.) or more in thickness, yellowish-brown in color, externally rough (Cassia), of fragrant odor, a sweet, aromatic taste, but less delicate than that of Ceylon cinnamon, which appears in large, closely rolled quills, composed of eight or more layers of bark of the thickness of paper; pale yellowish-brown, the outer surface smooth, marked with wavy lines of bast-bundles; of a very sweet, fragrant odor and a warm, aromatic, delicate taste. The Saigon cinnamon is found in the shops as large quills or broken pieces, $\frac{1}{12}$ to ⅛ inch (2 to 3 Mm.) thick; the outer surface gray or light grayish-brown, with whitish patches, more or less rough and warty, transversely ridged and longitudinally wrinkled; the inner surface cinnamon or dark brown, granular, and slightly striate, with short and granular fracture. It has a fragrant odor, and a sweet, warmly aromatic, and somewhat astringent taste.

Constituents.—All the varieties contain *volatile oil*, tannin, mucilage, sugar, starch, a coloring principle, and a peculiar acid.

The official oil of cinnamon is distilled from cassia cinnamon.

Dose.—5–30 grains (0.3–2.0 Gm.).

Official Preparations.

Tinctūra Cardamōmi Compŏsita—Tinctūræ Cardamōmi Compŏsitæ—Compound Tincture of Cardamom.—Cardamom, 25; Saigon cinnamon, 25; caraway, 12; cochineal, 5; glycerin, 50; diluted alcohol, q. s. ad 1000 parts. *Dose*, 1–2 fluidrams (4.0–8.0 Cc.) [1 dram (4 Cc.), U. S. P.].

Tinctūra Gămbir Compŏsita—Tinctūræ Gambĭris Compŏsitæ—Compound Tincture of Gambir.—Gambir, 50; Saigon cinnamon, 25; diluted alcohol, q. s. ad 1000 parts. *Dose*, ½–2 fluidrams (2.0–8.0 Cc.) [1 dram (4 Cc.), U. S. P.].

Tinctūra Lavandŭlæ Compŏsita—Tinctūræ Lavandŭlæ Compŏsitæ—Compound Tincture of Lavender.—*Dose*, ¼–1 fluidram (2.0–4.0 Cc.). (Formula given under *Lavender.*)

Tinctūra Cinnamōmi (20 per cent.)—**Tinctūræ Cinnamōmi—Tincture of Cinnamon.**—*Dose*, ½–2 fluidrams (2.0–8.0 Cc.) [30 minims (2 Cc.), U. S. P.].

Pŭlvis Aromăticus—Pulvĕris Aromătici—Aromatic Powder.—*Dose*, 10–30 grains (0.6–2.0 Gm.). (Formula given under *Cardamomum.*)

Ōleum Cinnamōmi—Ōlei Cinnamōmi—Oil of Cinnamon. *U. S. P.*

Origin.—A volatile oil distilled from Cassia cinnamon, yielding not less than 75 per cent. by volume of cinnamic aldehyde.

Description and Properties.—A yellowish or brownish liquid, becoming darker and thicker with age and exposure to the air, having the characteristic odor of cinnamon and a sweetish, spicy, burning taste. Specific gravity, 1.045–1.055 at 25° C. Soluble in an equal volume of alcohol, the solution being slightly acid to litmus-paper; also soluble in an equal volume of glacial acetic acid. It should be kept in well-stoppered bottles, in a cool place, protected from light.

Constituents.—Oil of cinnamon contains variable quantities of hydrocarbons, but consists chiefly of *cinnamic aldehyde*, $C_6H_5CHCHCOH$, and when old or exposed to the air for a considerable time cinnamic acid and resin are formed. *Cinnamic acid* crystallizes in shining, colorless, odorless prisms, freely soluble in alcohol, ether, and boiling water. Chlorinated lime and hot dilute nitric acid oxidize it into oil of bitter almond and benzoic acid.

Dose.—1–5 minims (0.06–0.3 Cc.).

Official Preparations.

Āqua Cinnamōmi (0.2 per cent.)—**Āquæ Cinnamōmi—Cinnamon Water.**—*Dose*, ½–1 fluidounce (15.0–30.0 Cc.) [4 drams (16 Cc.), U. S. P.].

Spĭritus Cinnamōmi (10 per cent.)—**Spĭritus Cinnamōmi—Spirit of Cinnamon.**—*Dose*, 5–20 minims (0.3–1.2 Cc.) [30 minims (2 Cc.), U. S. P.].

Cinnaldehȳdum—Cinnăldehȳdi—Cinnamic Aldehyde. *U. S. P.*

Definition.—An aldehyde, $C_6H_5CH:CH.COH$, obtained from oil of cinnamon or prepared synthetically. It is the chief and essential constituent of oil of cinnamon, and should be present to the extent of about 75 per cent. by volume in a good oil.

Description and Properties.—A colorless liquid, having a cinnamon-like odor and a burning, aromatic taste. It may be used for nearly all purposes in place of the official oil of cinnamon. Pure synthetic cinnamic aldehyde occurs in the market, and has to a great extent displaced the natural oil of cinnamon. Sparingly soluble in water, readily in alcohol, fixed and volatile oils.

Dose.—Average dose, 1 minim (0.05 Cc.), U. S. P.

Physiological Action.—Cinnamon is an agreeable aromatic stimulant, carminative, stomachic, astringent, hemostatic, and antiseptic. The oil possesses germicidal properties. It has a marked action on the vasomotor system, causing flushing and stimulating peristalsis. In poisonous doses its action approximates that of phenol.

Therapeutics.—The same as for other aromatics. It is much used to impart an agreeable flavor to medicinal compounds and as an adjuvant to other members of this group.

Coriăndrum—Coriăndri—Coriander. *U. S. P.*

Origin.—The dried fruit of *Coriandrum sativum* L., an annual herb about 2 feet (60.0 Cm.) high, indigenous in China and on the northeastern shore of the Mediterranean. Cultivated in Asia, Europe, and America.

Description and Properties.—Globular, about ⅛ inch (3 Mm.) in diameter, slightly pointed at the apex and crowned with the calyx-teeth at the base. The two concave mericarps cohere, enclosing a lenticular cavity, each furnished on the face with two oil-tubes; odor and taste agreeably fragrant and aromatic.

Constituents.—Coriander contains nearly ½ of 1 per cent. of volatile oil, 13 per cent. of fatty matter, mucilage, and traces of tannin.

Dose.—8–30 grains (0.5–2.0 Gm.) [7½ grains (0.5 Gm.), U. S. P.].

Ōleum Coriăndri—Ōlei Coriăndri—Oil of Coriander. *U. S. P.*

Origin.—A volatile oil distilled from coriander.

Description and Properties.—A colorless or slightly yellowish liquid, having the characteristic aromatic odor of coriander and a warm, spicy taste. It is one of the most stable of the volatile oils. Coriandrol, $C_{10}H_{18}O$, an alcohol, is its most characteristic ingredient.

Dose.—1–15 minims (0.06–0.3 Cc.) [3 minims (0.2 Cc.). U. S. P.].

Physiological Action and Therapeutics.—The same as those of the other volatile oils. Frequently used as a corrective to purgative medicines.

Fœnĭculum—Fœnĭculi—Fennel. *U. S. P.*

Origin.—The dried, nearly ripe fruit of *Fœniculum vulgare* Miller, a herbaceous annual or perennial indigenous in Southern Europe and cultivated in Germany, France, and the United States.

Description and Properties.—Oblong, nearly cylindrical, slightly curved, from ⅙ to ½ inch (4–12 Mm.) long, brownish or greenish-brown, readily separable

into the two prominent merricarps, each with five light-brown, obtuse ribs, with four oil-tubes on the back and two or four upon the flat face; odor and taste aromatic, anise-like.

Constituents.—Fennel contains from 2 to 4 per cent. of *volatile oil*, which is almost identical chemically with that of anise, 12.5 per cent. of fixed oil, and sugar.

Dose.—8–30 grains (0.5–2.0 Gm.) [15 grains (1 Gm.), U. S. P.].

Official Preparations.

Confĕctio Sĕnnæ—Confectiōnis Sĕnnæ—Confection of Senna (0.5 per cent.). —*Dose*, 1–2 drams (4.0–8.0 Gm.) [60 grains (4 Gm.), U. S. P.]. (Formula given under *Senna.*)

Infūsum Sĕnnæ Compŏsitum—Infūsi Sĕnnæ Compŏsiti—Compound Infusion of Senna.—*Dose*, 1–2 fluidounces (30.0–60.0 Cc.) [4 drams (120 Cc.), U. S. P.]. (Formula given under *Senna.*)

Ōleum Fœnĭculi—Ōlei Fœnĭculi—Oil of Fennel. *U. S. P.*

Origin.—A volatile oil distilled from fennel.

Description and Properties.—A colorless or pale-yellowish liquid, having the characteristic aromatic odor of fennel and a sweetish, mild, and spicy taste. Soluble in an equal volume of alcohol. It should be kept in well-stoppered bottles, in a cool place, and if it has partly or wholly solidified, it should be completely liquefied by warming before being dispensed.

Constituents.—It has constituents similar to those of the oil of anise.

Dose.—1–5 minims (0.06–0.3 Cc.) [3 minims (0.2 Cc.), U. S. P.].

Official Preparations.

Āqua Fœnĭculi (0.2 per cent.)—**Āquæ Fœnĭculi—Fennel Water.**—*Dose*, ¼–1 fluidounce (8.0–30.0 Cc.) [4 drams (16 Cc.), U. S. P.].

Pŭlvis Glycyrrhīzæ Compŏsitus—Pŭlveris Glycyrrhīzæ Compŏsiti—Compound Liquorice Powder.—*Dose*, ½–2 drams (2.0–8.0 Gm.) [60 grains (4 Gm.), U. S. P.]. (Formula given under *Senna.*)

Spĭritus Junĭperi Compŏsitus—Spĭritus Junĭperi Compŏsiti—Compound Spirit of Juniper (0.5 per cent.).—*Dose*, 2–4 fluidrams (8.0–15.0 Cc.). (Formula given under *Carum.*)

Physiological Action and Therapeutics are similar to those of anise.

Cārum—Cāri—Caraway. *U. S. P.*

Origin.—The dried fruit of *Carum Carvi* L., a biennial plant native to Central and Western Asia. It is cultivated in Europe and in the United States.

Description and Properties.—Oblong, laterally compressed, about ⅙ to ⅛ inch (4–5 Mm.) in length, tapering somewhat at the ends, brown, with five yellowish, filiform ribs and six oil-tubes. Caraway has an agreeable odor and a sweetish, spicy taste.

Constituents.—It contains from 5 to 7 per cent. of a volatile oil.

Dose.—15–30 grains (1.0–2.0 Gm.) [25 grains (1.6 Gm.), U. S. P.].

Official Preparation.

Tinctūra Cardamōmi Compŏsita—Tinctūræ Cardamōmi Compŏsitæ—Compound Tincture of Cardamom.—*Dose*, 1–2 fluidrams (4.0–8.0 Cc.) [1 dram (4 Cc.), U. S. P.]. (Formula given under *Cardamomum.*)

Ōleum Cāri—Ōlei Cāri—Oil of Caraway. *U. S. P.*

Origin.—A volatile oil distilled from caraway.

Description and Properties.—A colorless or pale-yellow, thin liquid, having the characteristic aromatic odor of caraway and a mild, spicy taste. Soluble in an equal volume of alcohol, this solution being neutral to litmus-paper.

By fractional distillation the oil may be separated into two portions : a light hydrocarbon with but little odor and taste, *carvene*; and a ketone having an agreeable caraway odor, *carvone* ($C_{10}H_{14}O$).

Dose.—1–10 minims (0.6–0.66 Cc.) [3 minims (0.2 Cc.), U. S. P.].

Official Preparation.

Spĭritus Junĭperi Compŏsitus—Spĭritus Junĭperi Compŏsiti—Compound Spirit of Juniper.—Oil of Juniper, 8; oil of caraway, 1; oil of fennel, 1; alcohol, 1400; water, q. s. ad 1000 parts. *Dose*, 2–4 fluidrams (8.0–15.0 Cc.) [2 drams (8 Cc.), U. S. P.].

Physiological Action and Therapeutics.—The same as those of the other aromatic oils.

Mȳrrha—Mȳrrhæ—Myrrh. *U. S. P.*

Origin.—A gum-resin obtained from *Commiphora Myrrha* (Nees) Engler, a shrub or small tree "forming the chief underwood of the Arabian and African forests along the shores of the Red Sea."

Description and Properties.—Roundish, irregular tears or masses, dusty brownish-yellow or reddish-brown; fracture waxy, somewhat splintery, translucent on the edges, sometimes marked with whitish veins; odor balsamic; taste aromatic, bitter, and acrid. It is a dried-up emulsion-like juice. It contains 60 per cent. of *gum*, 35 per cent. of *resin*, and 3 to 4 per cent. of a *volatile oil* of unknown composition, thought by Flückiger to contain carvone. It is now thought that there is no carvone in this oil.

Dose.—5–30 grains (0.3–2.0 Gm.), in pills or emulsion [7½ grains (0.5 Gm.), U. S. P.].

Official Preparations.

Mistūra Fĕrri Compŏsita—Mistūræ Fĕrri Compŏsitæ—Compound Iron Mixture.—*Dose*, ½–2 fluidounces (15–16 Cc.) [4 drams (16 Cc.), U. S. P.].

Pilūlæ Ăloes et Mȳrrhæ—Pĭlulas (acc.) Ăloes et Mȳrrhæ—Pills of Aloes and Myrrh.—*Dose*, 2–5 pills [2 pills, U. S. P.].

Tinctūra Ăloes et Mȳrrhæ—Tinctūræ Ăloes et Mȳrrhæ—Tincture of Aloes and Myrrh (10 per cent.).—*Dose*, ½–2 fluidrams (2–8 Cc.) [30 minims (2 Cc.), U. S. P.].

Tinctūra Mȳrrhæ—Tinctūræ—Mȳrrhæ Tincture of Myrrh (20 per cent.).—*Dose*, 15–60 minims (1–4 Cc.) [15 minims (1 Cc.), U. S. P.].

Physiological Action.—Myrrh is astringent, disinfectant, slightly antiseptic, and stimulant. Its action resembles that of the aromatics, stimulating the appetite and acting as a carminative, excessive doses causing nausea and vomiting.

The drug is eliminated by the mucous membranes generally, augmenting and disinfecting their secretions. It possesses emmenagogue properties.

Therapeutics.—As a stimulant and astringent myrrh is serviceable as a mouth-wash in *ptyalism* and *spongy gums* and in *ozena*. It is useful as a gargle in *pharyngitis*, *relaxed throat*, etc., and as an injection in *leukorrhea*, the latter disease, as well as *cystitis*, being favorably influenced by the internal administration of the drug. It

has been used internally, with considerable success, as a stimulant expectorant in *bronchorrhea* and *chronic bronchitis*, and as a stomachic in *atonic dyspepsia*.

Administration.—Myrrh may be given internally in the form of an emulsion or pills. The tincture, either in full strength or diluted, is chiefly employed externally.

Eucalyptus—Eucalypti—Eucalyptus. *U. S. P.*

Origin.—The dried leaves of *Eucalyptus globulus* Labillardière, collected from the older part of the tree. The *blue-gum tree* is a rapid grower, attaining a height of 200 to 300 feet (60–90 M.). It is native to Australia, but is cultivated in various portions of Europe, Africa, and the United States with the view of rendering malarial districts habitable by its antiseptic exhalations. Its efficacy in this direction is due solely to its using large quantities of water for its growth, thereby depriving the malarial-bearing mosquitoes of the marshy grounds in which they develop their larvæ.

Description and Properties.—Petiolate, lanceolate, scythe-shaped, from 6 to 12 inches (15–30 Cm.) long, rounded below, tapering above, entire, leathery, grayish-green, glandular, feather-veined between the midrib and marginal veins; odor strongly camphoraceous; taste pungently aromatic and somewhat cooling, bitter, and astringent.

The most important constituent is a *volatile oil*, of which the leaves yield about 6 per cent.

Dose.—½–2 drams (2.0–8.0 Gm.) [30 grains (2 Gm.), U. S. P.].

Official Preparation.

Fluidextractum Eucalypti—Fluidextracti Eucalypti—Fluidextract of Eucalyptus.—*Dose*, 5–60 minims (0.3–4.0 Cc.) [30 minims (2.0 Cc.), U. S. P.].

Oleum Eucalypti—Olei Eucalypti—Oil of Eucalyptus. *U. S. P.*

Origin.—A volatile oil distilled from the fresh leaves of *Eucalyptus globulus* Labillardière and from other sources.

Description and Properties.—A colorless or faintly yellowish liquid, having a characteristic, aromatic, somewhat camphoraceous odor and a pungent, spicy, and cooling taste. Soluble in all proportions in alcohol. This oil consists of a mixture of hydrocarbons, the most striking of which is *eucalyptol*, probably identical with *cineol*, $C_{10}H_{18}O$, one of the most widely distributed of the oxides of the hydrocarbons. It should be kept in well-stoppered bottles, in a cool place, protected from light.

Dose.—5–15 minims (0.3–1.0 Cc.) [8 minims (0.5 Cc.), U. S. P.].

Eucalyptol—Eucalyptolis—Eucalyptol. *U. S. P.*

Definition.—An organic oxide (cineol) obtained from the volatile oil of *Eucalyptus globulus* and from other sources. It is also found in a great many other volatile oils; oil of cajuput being one of those most widely known.

Description and Properties.—A colorless liquid, having a characteristic, aromatic, and distinctly camphoraceous odor and a pungent, spicy, and cooling taste. Soluble in all proportions in alcohol.

Dose.—5–10 minims (0.3–0.6 Cc.) [5 minims (0.3 Cc.), U. S. P.].

Physiological Action.—*Externally and Locally.*—Locally applied, the oil of eucalyptus and *eucalyptol* are more or less irritant, though perhaps less active than many volatile oils. They do not differ in any particular regard from others of this class. The resemblances of eucalyptus to quinine are largely fanciful.

Therapeutics.—Eucalyptus is a valuable remedy in chronic inflammation of mucous membranes, especially in atrophic rhinitis, where it is best applied in spray combined with a liquor petroleum excipient in the proportion of 30–60 minims (2-4 Cc. to the ounce —33 Gm.).

It has proved of service in acute and chronic skin diseases, notably simple dermatitis, and in chronic forms of eczema and psoriasis. As others of the turpentine series, it is a stimulant to sluggish ulcers.

The chief value of this drug lies perhaps in its effects upon the urine in its elimination. It is an active antiseptic and is useful in cystitis and pyelitis.

As a stimulant expectorant eucalyptus is of great value, equaling, if not being superior to, any other remedy in *bronchorrhea*, *pulmonary gangrene*, and *fetid bronchitis*, associated or not with phthisis. Chronic or catarrhal conditions of the lungs and bronchi only are benefited by eucalyptus, acute affections of the broncho-pulmonary mucous membrane contraindicating its use. A solution of oil of eucalyptus is used as an antiseptic inhalation in *diphtheria*.

Administration.—The fresh leaves may be employed as poultices. Any of the preparations may be used, but for internal purposes the oil, or eucalyptol, is preferable, although a good fluid extract is an agreeable form of the medicine. The oil, or eucalyptol, may be given in an emulsion or in capsules, for topical use being diluted with alcohol or oil or incorporated in suppositories or ointments.

Ōleum Cajupūti—Ōlei Cajupūti—Oil of Cajuput. *U. S. P.*

Origin.—A volatile oil distilled from the fresh leaves and twigs of *Melaleuca leucadendron* L., a tree with crooked stem and scattered branches, resembling the weeping willow, indigenous in the East Indies. It should yield not less than 55 per cent. by volume of cineol.

Description and Properties.—A light, thin, bluish-green, or, after rectification, colorless liquid, having a peculiar, agreeable and distinctly camphoraceous odor, and an aromatic, bitterish taste. Specific gravity, 0.925 at 25° C. With an equal volume of alcohol it affords a clear solution, which either has a slightly acid reaction or, in the case of the rectified oil, is neutral to litmus-paper.

Constituents.—The chief constituent is cineol.

Dose.—1-5 minims (0.06–0.3 Cc.) [8 minims (0.5 Cc.), U. S. P.].

Physiological Action and **Therapeutics** are identical with those of the oil of cloves.

Cardamōmum—Cardamōmi—Cardamom. *U. S. P.*

Origin.—The dried, nearly ripe fruit of *Elettaria repens* (Sonnerat) Baillon, a perennial plant 6 to 10 feet (1.8–3.0 M.) high.

Cardamom is indigenous in Hindustan, in the mountainous regions of Malabar.

The same plant furnishes three varieties of cardamoms, known in commerce as the *shorts*, *short-longs*, and *long-longs*.

Description and Properties.—Ovoid or oblong, from ½ to ¾ inch (12 Mm.–2 Cm.) long, obtusely triangular, rounded at the base, beaked, longitudinally striate;

of a pale-buff color, three-celled, with a thin, leathery, nearly tasteless pericarp and a central placenta. The seeds are about ⅕ inch (5 Mm.) long and ⅛ inch (3 Mm.) broad, reddish-brown, angular, rugose, depressed at the hilum, surrounded by a thin membranous arillus. They have an agreeable odor and a pungent, aromatic taste.

Dose.—5–15 grains (0.3–1.0 Gm.) [15 grains (1 Gm.), U. S. P.].

Official Preparations.

Tinctūra Cardamōmi (20 per cent.)—**Tinctūræ Cardamōmi—Tincture of Cardamom.**—*Dose*, 1–2 fluidrams (4.0–8.0 Cc.) [1 dram (4 Cc.), U. S. P.].

Tinctūra Cardamōmi Compŏsita—Tinctūræ Cardamōmi Compŏsitæ—Compound Tincture of Cardamom.—Cardamom, 25; Saigon cinnamon, 25; caraway, 12; cochineal, 5; glycerin, 50; dilute alcohol, q. s. ad 1000 parts. *Dose*, 1–2 fluidrams (4.0–8.0 Cc.) [1 dram (4 Cc.), U. S. P.].

Pŭlvis Aromăticus—Pŭlveris Aromătici—Aromatic Powder.—Saigon cinnamon, 35; ginger, 35; cardamom, 15; nutmeg, 15. *Dose*, 10–30 grains (0.6–2.0 Gm.) [15 grains (1 Gm.), U. S. P.].

There is also a fluidextract, **fluidextractum aromaticum**, made from this powder. *Dose*, 10–30 minims (0.6–2.0 Cc.) [15 minims (1 Cc.), U. S. P.].

Antagonists and Incompatibles.—Free acids are incompatible with the compound tincture of cardamom, separating insoluble carminic acid in it.

Physiological Action.—In this respect cardamom conforms to the general character of the Aromatic Group.

Therapeutics.—Essentially the same as for other members of this group. Cardamom is used principally as an adjuvant to other aromatics, stimulants, stomachics, and carminatives.

Călamus—Călami—Calamus. *U. S. P.*

(Sweet Flag.)

Origin.—The unpeeled, dried rhizome of *Acorus Calamus* L., a plant indigenous in North America, Europe, and Western Asia, growing in swamps and along the shores of streams and ponds.

Description and Properties.—Calamus is found in subcylindrical sections of various lengths, about 1 inch (2 Cm.) broad, externally reddish-brown, internally whitish, of a spongy texture, breaking with a short, corky fracture, showing numerous oil-cells and scattered wood-bundles. It has a strong aromatic, fragrant odor and a warm, peculiar, bitterish taste. Calamus contains from 1 to 2 per cent. of volatile oil possessing the odor and taste of calamus, a glycosid (acorin) in the form of a bitter, yellow syrupy liquid, besides calamine, choline, resin, starch, and mucilage.

Dose.—15–60 grains (1.0–4.0 Gm.) [15 grains (1 Gm.), U. S. P.].

Official Preparation.

Fluidextrăctum Călami—Fluidextrăcti Călami—Fluidextract of Calamus.—*Dose*, 15–60 minims (1.0–4.0 Cc.) [30 minims (2.0 Cc.), U. S. P.].

Physiological Action and Therapeutics.—The action of calamus is similar to that of anise, but is more tonic than the latter. Large doses of the volatile oil produce tetanic convulsions.

It is used for the same purposes as anise, but probably possesses more stomachic and carminative properties.

Ōleum Lavăndulæ Flōrum—Ōlei Lavăndulæ Florum—Oil of Lavender Flowers. *U. S. P.*

Origin.—A volatile oil distilled from fresh flowering tops of *Lavandula officinalis* Chaix. Lavender is a native to Southern Europe and cultivated in gardens.

Description and Properties.—A colorless or yellowish liquid, having the fragrant odor of lavender flowers and a pungent and bitterish taste. Soluble in all proportions of alcohol. It should be kept in well-stoppered bottles, in a cool place, protected from light.

Dose.—1–5 minims (0.06–0.03 Cc.) [3 minims (0.2 Cc.), U. S. P.].

Official Preparations.

Spĭritus Lavăndulæ (5 per cent.)—**Spĭritus Lavăndulæ—Spirit of Lavender.** —*Dose*, ½–1 fluidram (2.0–4.0 Cc.) [30 minims (2 Cc.), U. S. P.].

Tinctūra Lavăndulæ Compŏsita—Tinctūræ Lavăndulæ Compŏsitæ—Compound Tincture of Lavender.—Oil of lavender, 8; oil of rosemary, 2; Saigon cinnamon, 20; cloves, 5; nutmeg, 10; red saunders, 10; alcohol, water, āā q. s. ad 1000 parts. *Dose*, ½–1 fluidram (2.0–4.0 Cc.) [30 minims (2 Cc.), U. S. P.]. Compound tincture of lavender is an ingredient of liquor potassii arsenitis.

Physiological Action and **Therapeutics** are the same as those of other volatile oils mentioned in this group.

Mĕntha Piperīta—Mĕnthæ Piperītæ—Peppermint. *U. S. P.*

Origin.—The dried leaves and flowering tops of *Mentha piperita* Smith, a perennial plant found in damp places in England and other European countries and in North America.

Peppermint contains about 1 per cent. of a *volatile oil*—its most important constituent.

Dose.—60 grains (4 Gm.), U. S. P.

Ōleum Mĕnthæ Piperītæ—Ōlei Mĕnthæ Piperītæ—Oil of Peppermint. *U. S. P.*

Origin.—A volatile oil distilled from the fresh or partly dried leaves and flowering tops of peppermint, yielding not less than 8 per cent. of ester, calculated as menthyl acetate, and not less than 50 per cent. of total menthol.

Description and Properties.—A colorless liquid, becoming darker and thicker by age and exposure to the air, having the characteristic strong odor of peppermint and a strongly aromatic, pungent taste, followed by a sensation of cold upon inhalation. It forms a clear solution with an equal volume of alcohol, becoming turbid when further diluted, and is soluble in all proportions in carbon disulphide and in glacial acetic acid.

When exposed to a freezing temperature the oil becomes thick and cloudy, and separates crystals of *menthol*, to which it owes its peculiar odor.

Dose.—1–5 minims (0.06–0.3 Cc.) [3 minims (0.2 Cc.), U. S. P.].

Official Preparations.

Āqua Mĕnthæ Piperītæ (0.2 per cent.)—**Āquæ Mĕnthæ Piperītæ—Peppermint Water.**—*Dose*, ½–1 fluidounce (15.0–30.0 Cc.) [4 drams (16 Cc.), U. S. P.].

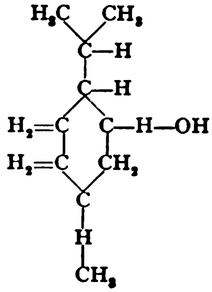
Spĭritus Mĕnthæ Piperītæ (10 per cent.)—**Spĭritus Mĕnthæ Piperītæ—Spirit, or Essence, of Peppermint.**—*Dose*, 5–60 minims (0.3–0.4 Cc.) [30 minims (2 Cc.), U. S. P.].

Spirit of peppermint is an ingredient of mistura rhei et sodæ.

Mĕnthol—Mĕntholis—Menthol. *U. S. P.*

Definition.—A secondary alcohol, $C_6H_9(CH_3)(OH)(C_3H_7)$ 1 : 3 : 4, obtained from the oil of *Mentha piperita* L. or other peppermint oils.

Description and Properties.—Colorless, acicular, or prismatic crystals, having a strong and pure odor of peppermint and a warm, aromatic taste, followed by a sensation of cold when air is inhaled. Menthol is but slightly soluble in water, but imparts to the latter its odor and taste. It is freely soluble in alcohol, ether, chloroform, carbon disulphide, and glacial acetic acid. It is a saturated secondary alcohol, with the following formula:



Dose.—½–2 grains (0.03–0.12 Gm.) [1 grain (0.065 Gm.), U. S. P.].

Physiological Action and Therapeutics.—*Externally and Locally.*—MENTHOL is an antiseptic, antipruritic, analgesic, and anesthetic, as well as a germicide. It is used for the same purposes as oil of cloves. It is used extensively in *headache*, being rubbed on the forehead. Owing to its analgesic properties, it is used in the form of an ointment in various strengths for painful *hemorrhoids*, *burns*, *boils*, and *superficial inflammations.*

The OIL OF PEPPERMINT, or MENTHOL, is an ingredient of many sprays and lotions for the treatment of diseases of the *ear*, *nose*, and *throat.*

As an antipruritic MENTHOL is a valuable remedy to relieve the itching of *eczema*, *pruritus*, *urticaria*, etc. It should be dissolved in oil for this purpose—in severe cases 50 grains to 1 ounce (3.2 Gm. to 30.0 Cc.).

Internally.—The uses of OIL OF PEPPERMINT are similar to those of other aromatic oils, it being a valuable carminative, stimulant, antifermentative, and antispasmodic. In small doses MENTHOL has been given to allay *nausea* and *vomiting* and to relieve the pain of *gastralgia.*

Mĕntha Vĭridis—Mĕnthæ Vĭridis—Spearmint. *U. S. P.*

Definition.—The dried leaves and flowering tops of *Mentha spicata* L.

This is one of the mints, found in the same localities as peppermint, and containing, like the latter drug, a volatile oil forming its active constituent. It possesses milder properties than peppermint, although similar to it in its action and uses. To some people it has a more agreeable taste than peppermint, and in infantile cases it is usually preferred.

Official Preparations.

Aqua Menthæ Viridis—Aquæ Menthæ Viridis—Spearmint Water.

Spiritus Menthæ Viridis—Spiritus Menthæ Viridis—Spirit, or Essence, of Spearmint. *Dose*, 30 minims (2 Cc.), U. S. P.

Oleum Menthæ Viridis—Olei Menthæ Viridis—Oil of Spearmint.—The *dose* of the oil of spearmint and of the above preparations is the same as for the corresponding oil and preparations of peppermint.

Thȳmol—Thȳmol—Thymol. *U. S. P.*

Origin.—A phenol, $C_6H_3.(CH_3).(OH)(C_3H_7)$ 1 : 3 : 4, occurring in the volatile oils of *Thymus vulgaris* L., and in some other volatile oils.

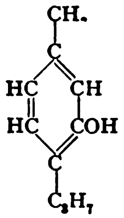
Description and Properties.—Large, colorless, translucent crystals of the hexagonal system, having an aromatic, thyme-like odor and a pungent, aromatic taste, with a very slight caustic effect upon the lips. Its specific gravity as a solid is 1.030, but when liquefied by fusion it is lighter than water. It is soluble in about 1100 parts of water and in less than its own weight of alcohol, ether, or chloroform; also readily soluble in carbon disulphide, glacial acetic acid, and in fixed or volatile oils. When triturated with about equal quantities of camphor, menthol, or chloral, it liquefies.

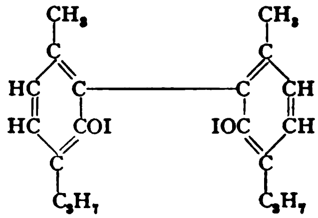
Dose.—1–5 grains (0.06–0.3 Gm.) [2 grains (0.125 Gm.), U. S. P.].

Thȳmolis Iodīdum—Thȳmolis Iodīdi—Thymol Iodide. *U. S. P.*

(ARISTOL.)

Definition.—Dithymol-diiodide, $(C_6H_2.CH_3.C_3H_7.OI)_2$, obtained by the condensation of two molecules of thymol (a methylisopropylphenol) and the introduction into its phenolic group of two atoms of iodine. It contains 45 per cent. of iodine.


Thymol.


Dithymol-diiodide (thymolis iodidum).

Description and Properties.—A bright, chocolate-colored or reddish-yellow, bulky powder, almost tasteless, and having a slight aromatic odor. Insoluble in water and glycerin, soluble with difficulty in alcohol, readily soluble in fatty oils and in ether, vaseline, chloroform, and collodion.

Allied and Derived Compounds.—Many other derivatives or compounds of thymol have been suggested for therapeutic use—*e. g.*, *thymotal* (thymol-carbonate), *thymacetin* (analogous to *phenacetin*), *thymoform* (condensation product of thymol and formaldehyde), *iodothymoform* (iodized *thymoform*), mercury compound of thymol, *thymosalol*, etc.

Physiological Action.—Thymol is a powerful antiseptic, being ten times less poisonous than carbolic acid because of its slow absorption, yet as an antiseptic far superior to it. While stimulant, it is not irritant or corrosive. It is also a deodorant, disinfectant, parasiticide, and local anesthetic, as well as an antipruritic, antipyretic, and antifermentative.

Absorption and Elimination.—It is eliminated chiefly by the

lungs and kidneys, producing some irritation at the points of elimination. The urine is increased in quantity, often assuming a dark-greenish hue, due to dioxybenzols.

Untoward Action.—The following symptoms have been produced by the administration of large doses: burning sensation in the mouth and stomach, persisting in some instances for days, accompanied by pain and tenderness under pressure. According to Bälz, "perspiration is sometimes observed, and occasionally a transient buzzing in the ears and deafness."

Poisoning.—In addition to untoward manifestations, there may be nausea and vomiting, profuse sweating, great reduction of temperature, dizziness, violent delirium, and collapse.

Therapeutics.—*Externally and Locally.*—The applications of thymol in surgery are identical with those of carbolic acid.

Crocker in 1878 introduced it as an efficient remedy in certain *skin diseases.* It probably owes its value in these cases to its antipruritic and antiparasitic properties.

It is also extensively used in diseases of the *nose, throat,* and *ear,* and in certain disorders of the *genito-urinary tract.* Thymol is also administered by inhalation in certain *broncho-pulmonary disorders.*

Internally.—Thymol is used for the same purposes as other antiseptics, such as carbolic acid, resorcin, beta-naphtol, etc.

Martini highly recommends it as an intestinal antiseptic in the treatment of *diarrhea, dysentery,* and *typhoid fever.*

It has been employed with some success in limiting fermentation during a proteid diet in the treatment of *diabetes.* It has also been favorably recommended in *phthisis, vesical catarrh, stomatitis,* and *diphtheria.* Thymol is the most efficient anthelmintic for the hook-worm, *Uncinaria duodenale* and *Uncinaria americana,* in doses of 5–20 grains. For the action of aristol see iodine.

Administration.—It may be applied externally in solution (1 : 1000), as an ointment (1–10 per cent.), or in the form of thymol gauze as a surgical dressing (1 per cent. of thymol).

For internal use it should be given in pills or capsules.

II. CONDIMENT GROUP.

Căpsicum—Căpsiçi—Capsicum. *U. S. P.*

(Cayenne Pepper.)

Origin.—The dried ripe fruit of *Capsicum fastigiatum* Blume, deprived of its calyx. Capsicum fastigiatum is a small crooked-branched shrub, 1 to 2 feet (30.0–60.0 Cm.) high, indigenous in tropical America and Asia, and cultivated in gardens. The fruit is an oblong-conical pod from ⅓ to ¾ inch (8–19 Mm.) long, of a crimson or yellow color. It encloses two or three cells containing flat, reniform, yellowish seeds, attached to a thick, central placenta. These pods when dried and ground form capsicum, which has a peculiar odor and an intensely hot, aromatic taste. This ground product is of a bright-red color, fading upon long exposure to the light. Capsicum of the market usually consists of several species ground together, and is often adulterated with sawdust and sometimes with red lead.

Constituents.—Capsicum contains *capsaicin*, an acrid principle found in the greatest amount in the African product; also a volatile alkaloid, fixed and volatile oil, and fat acids.

Dose.—3–5 grains (0.2–0.3 Gm.) [1 grain (0.065 Gm.), U. S. P.].

Official Preparations.

Fluidextrăctum Căpsici—Fluidextrăcti Căpsici—Fluidextract of Capsicum.—*Dose*, ½–2 minims (0.03–0.12 Cc.) [1 minim (0.05 Cc.), U. S. P.].

Emplăstrum Căpsici—Emplăstrum (acc.) **Căpsici—Capsicum Plaster.** For external use.

Oleoresīna Căpsici—Oleoresīnæ Căpsici—Oleoresin of Capsicum.—*Dose*, ¼–1 minim (0.015–0.06 Cc.) [½ grain (0.03 Gm.), U. S. P.].

Tinctūra Căpsici—Tinctūræ Căpsici—Tincture of Capsicum.—*Dose*, 5–20 minims (0.3–1.2 Cc.) [8 minims (0.5 Gm.), U. S. P.].

Physiological Action.—*Externally and Locally.*—Capsicum is an irritant and rubefacient, producing vesication if kept in contact with the skin for a long time. It so irritates the mucous membrane of the mouth and nose as to induce sneezing.

Internally.—Digestive System.—Capsicum is a powerful gastro-intestinal stimulant, increasing the flow from the salivary, gastric, and intestinal glands. It increases the blood-supply to, and stimulates the walls of, the stomach, occasioning a sense of heat. It is a powerful carminative. Large doses produce great irritation in the stomach and bowels.

Circulatory System.—It is a powerful stimulant to the heart, greatly increasing the strength and rapidity of its action.

Absorption and Elimination.—It is chiefly eliminated by the kidneys, increasing the flow of urine. Large doses may produce vesical tenesmus, and aphrodisiac effects have sometimes been produced.

Therapeutics.—*Externally and Locally.*—Owing to its counter-irritant action, capsicum is employed to relieve *lumbago*, *torticollis*, *neuralgia*, *rheumatic pains*, and *acute inflammation of the skin* or *mucous membrane*. An infusion or the diluted tincture is an excellent gargle in *relaxed uvula*, *pharyngitis*, and the *angina of scarlet fever*.

The tinctures of capsicum and cantharides have been used to stimulate the scalp in the various forms of *alopecia*. The tincture is frequently used as a domestic remedy for the benefit of *chilblains* and *toothache*.

Internally.—Capsicum is a most valuable stomachic in an atonic condition of the digestive organs, and a very efficient remedy in the *irritable* and *catarrhal conditions of the stomach* due to the excessive use of alcohol.

The tincture of capsicum or the powdered drug, added to hot water or to hot water and whisky, makes a valuable and rapid cardiac and vascular stimulant.

Contraindications.—Capsicum and its preparations should not be given in acute inflammatory affections of the gastro-intestinal and genito-urinary tracts.

Administration.—The oleoresin and the powder should be given in pills or capsules. The fluidextract and the tincture should be administered well diluted with water.

Pīper—Pīperis—Pepper. *U. S. P.*

(BLACK PEPPER.)

Origin.—The dried unripe fruit of *Piper nigrum* L., a knotted, pointed-branched, aromatic, climbing shrub, indigenous in India, and cultivated in many of the East Indian and Philippine and some of the West Indian islands.

Constituents.—Its important constituents are a *volatile oil* (1 to 2 per cent.); a neutral principle, *piperin* (6 to 8 per cent.); and a pungent, soft, dark-green *resin*, to which the acrid taste and medicinal properties of pepper are due.

Dose.—5–20 grains (0.3–1.2 Gm.) [7½ grains (0.5 Gm.), U. S. P.].

Official Preparations.

Oleoresīna Pīperis—Oleoresīnæ Pīperis—Oleoresin of Pepper.—*Dose*, ¼–1 grain (0.015–0.06 Gm.) [½ grain (0.03 Gm.), U. S. P.].

Piperīnum—Piperīni—Piperin.—*Origin.*—A feebly basic substance ($CH_2O_2.C_6H_3$, $CH:CH.CH:CH.CON.C_5H_{10}$) obtained from pepper, as well as from other plants of the natural order *Piperaceæ*.

Description and Properties.—Colorless or pale-yellowish, shining, prismatic crystals, odorless, and almost tasteless when first taken into the mouth, but after a while producing a sharp, biting sensation. Permanent in the air; almost insoluble in water, but soluble in 15 parts of alcohol and in 1 part of boiling alcohol.

Dose.—1–10 grains (0.03–0.6 Gm.) [3 grains (0.2 Gm.), U. S. P.].

Derivative Compound.

Piperonal—Heliotropin.—Obtained from piperic acid by oxidation. It occurs in small white crystals, soluble in about 600 parts of cold water, and very readily soluble in alcohol and ether. The *dose* is 10–15 grains (0.6–1.0 Gm.). It has been used as an antiseptic and antipyretic.

Physiological Action and **Therapeutics** of pepper and its preparations are almost identical with those of capsicum.

Pepper, particularly piperin, possesses antiperiodic and antiseptic properties to a greater extent than capsicum.

Myrīstica—Myrīsticæ—Nutmeg. *U. S. P.* Macis—Macis—Mace.

Definition.—The kernel of the ripe seeds of *Myristica fragrans* Houttuyn.

Origin.—The seed (Myristica) and the membrane, "arillode," investing the kernel (Mace) of *Myristica fragrans* Houttuyn, a tree about 30 feet (9 M.) high, found in the Molucca Islands and cultivated in the East Indies.

Ōleum Myrīsticæ—Ōlei Myrīsticæ—Oil of Nutmeg. *U. S. P.*

Origin.—A volatile oil distilled from myristica.

Description and Properties.—A thin, colorless, or pale-yellowish liquid, having the characteristic odor of nutmeg, and a warm, spicy taste. It becomes darker

and thicker by age and exposure to the air. Soluble in an equal volume of alcohol. It should be kept in well-stoppered bottles, in a cool place, protected from light. Its most important ingredients are pinene, myristol, myristicin, and a phenol.

Dose.—1–3 minims (0.06–0.18 Cc.) [3 minims (0.2 Cc.), U. S. P.].

Physiological Action and **Therapeutics** are the same as those of anise.

Caryophyllus—Caryophylli—Cloves. *U. S. P.*

Origin.—The dried flower buds of *Eugenia aromatica* (L.) O. Kuntze, a hard-wood, shrubby evergreen. It was originally found in the Molucca Islands, whence it was introduced and cultivated among the East Indian Islands.

Description and Properties.—The buds are about ⅝ inch (15 Mm.) long, dark-brown, consisting of a subcylindrical, solid and glandular calyx-tube, terminated by four teeth and surmounted by a globular head, formed by four petals covering numerous curved stamens, and one style. A clove resembles a nail (L. *clavus;* Fr. *clou*).

Cloves have a strong aromatic odor and a pungent, spicy taste, and when pressed or scratched emit oil.

Constituents.—Cloves contain about 18 per cent. of a highly pungent volatile oil, 17 per cent. of tannin, and small quantities of fixed oil, gum, resin, etc. The most important constituent of the oil is the phenol, *eugenol*, $C_{10}H_{12}O_2$, making up 70 to 85 per cent. of the oil, also a terpenene, caryophyllene; methyl alcohol and furfurol are present in small quantities.

Dose.—5–10 grains (0.3–0.6 Gm.) [4 grains (0.25 Gm.), U. S. P.].

Official Preparation.

Tinctūra Lavăndulæ Compŏsita—Tinctūræ Lavăndulæ Compŏsitæ—Tincture of Lavender.—*Dose,* ½–1 fluidram (2.0–4.0 Cc.). (Formula given under *Lavender.*)

Ōleum Caryophylli—Ōlei Caryophylli—Oil of Cloves. *U. S. P.*

Origin.—A volatile oil distilled from cloves, yielding not less than 80 per cent. by volume of eugenol.

Description and Properties.—A pale-yellow, thin liquid, becoming darker and thicker by age and exposure to the air, having a strongly aromatic odor of cloves and a pungent, spicy taste. Its specific gravity is 1.060–1.067. Soluble in an equal volume of alcohol, the solution being slightly acid to litmus-paper.

Constituents.—Oil of cloves consists of a light and a heavy oil, the former a hydrocarbon, supposed to be inactive; the latter a phenol-like liquid termed *eugenol*, a colorless oil with the odor of cloves, a specific gravity of 1.076–1.0785, yielding with bases crystalline salts.

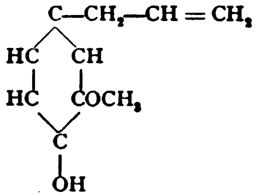
Dose.—1–10 minims (0.06–0.6 Cc.).

Eūgenol—Eūgenolis—Eugenol. *U. S. P.*

Definition.—An unsaturated, aromatic phenol, $C_6H_3(OH)(OCH_3).C_3H_5$ 4 : 3 : 1, obtained from oil of cloves and other sources.

Description and Properties.—A colorless or pale-yellow, thin liquid, highly refractive, and having a strongly aromatic odor of cloves and a pungent, spicy taste. Almost insoluble in water, easily soluble in alcohol; should be soluble in 2 parts of 70 per cent. alcohol. This is the chief constituent of oil of cloves, and may be used instead of the latter; it is also the chief constituent of oil of pimenta.

Chemically it is para-oxy-meta-methoxy-allyl-benzol, having the formula:



Dose.—Average dose, 3 minims (0.2 Cc.), U. S. P.

Allied Compounds and Derivatives.

Bĕnzoyl-eŭgenol.—*Origin.*—From eugenol.

Description and Properties.—It occurs in neutral, odorless, colorless, acicular crystals, having a feebly bitter taste; soluble in hot alcohol, ether, and chloroform, and insoluble in water.

Dose.—Not yet determined.

Cinnămyl-eŭgenol.—*Origin.*—A derivative of eugenol.

Description and Properties.—Colorless, odorless, tasteless, lustrous needles, soluble in hot alcohol, ether, and chloroform, and insoluble in water.

Eŭgenyl-acĕtamide.—*Origin.*—Obtained from eugenol-acetic-ethyl-ether by treating with solution of ammonia. It occurs as a crystalline powder.

Physiological Action.—*Externally and Locally.*—OIL OF CLOVES is a counterirritatant, local anesthetic, and germicide.

Internally.—Its action is essentially the same as that of anise, it being a powerful carminative and stimulant.

Therapeutics.—*Externally and Locally.*—OIL OF CLOVES is employed as a local anesthetic in *toothache*, *earache*, and *neuralgia*, and as a synergist to other counterirritants, rubefacients, and antiseptics. The EUGENOL-ACETAMIDE is a powerful local anesthetic, being analogous to cocaine in its action.

Internally.—The therapeutics are similar to those of anise. The BENZOYL-EUGENOL has been highly recommended by some practitioners as a valuable remedy in *tuberculosis*. The following combination may be employed as an antiseptic and antifermentative in *gastric fermentation*, to be administered either in soft capsules, with olive oil as a vehicle, or in the form of an emulsion:

℞ Olei caryophylli,
Olei cinnamomi,
Olei menthæ piperitæ,
Creosoti, *āā* ♏j.—M.
Sig.—Take at one time.

The better way to administer it is in the form of soft capsules, each capsule containing the above dose in about 6 minims (0.37 Cc.) of olive oil. One or two capsules should be given three times a day, after meals.

Pimĕnta—Pimĕntæ—Pimenta. *U. S. P.*

(ALLSPICE.)

Origin.—The dried, nearly ripe fruit of *Pimenta officinalis* Lindley, an evergreen tree about 30 feet (9 M.) high, indigenous in the West Indies, Central America, and the northern part of South America.

Constituents.—The most important constituent is the *volatile oil*, of which the fruit yields from 3 to 4 per cent.

Ōleum Piměnta—Ōlei Piměntæ—Oil of Allspice. U. S. P.

Origin.—A volatile oil distilled from pimenta, yielding not less than 65 per cent. by volume of eugenol.

Description and Properties.—A colorless or pale-yellow liquid, having a strong, aromatic, clove-like odor and a pungent, spicy taste. It becomes darker and thicker with age and exposure. The active ingredient of the oil is eugenol.

Dose.—1–5 minims (0.06–0.3 Cc.) [30 minims (0.2 Cc.), U. S. P.].

Physiological action and **therapeutics** are similar to those of cloves.

Zĭngiber—Zingĭberis—Ginger. U. S. P.

Origin.—The dry rhizome of *Zingiber officinale* Roscoe, a perennial herb indigenous in tropical Asia and now cultivated in most tropical countries.

Description and Properties.—A thick, flattish rhizome from 1 to 4 inches (25 to 100 Mm.) long, with club-shaped lobes on one side; deprived of the corky layer, pale, buff-colored, striate, breaking with a mealy, rather fibrous fracture, showing numerous small, scattered resin-cells and fibro-vascular bundles, the latter enclosed by a nucleus sheath. Agreeably aromatic and of a warm, pungent taste.

Ginger contains about 0.75 to 2 per cent. of a pale-yellow *volatile oil* of uncertain composition, to which the ginger owes its aromatic properties; also a soft *resin*, giving to the drug its hot, pungent taste. The proportion of resin present varies with the different varieties of ginger, that from the East Indies yielding about 8 per cent., while the Jamaica product yields only about 5 per cent.

Dose.—8–30 grains (0.5–2.0 Gm.) [15 grains (1 Gm.), U. S. P.].

Official Preparations.

Fluidextrăctum Zingĭberis—Fluidextrăcti Zingĭberis—Fluidextract of Ginger.—*Dose*, 10–30 minims (0.6–2.0 Cc.) [15 minims (1 Cc.), U. S. P.].

Oleoresīna Zingĭberis—Oleoresīnæ Zingĭberis—Oleoresin of Ginger.—*Dose*, 1–3 grains (0.06–0.18 Gm.) [½ grain (0.03 Gm.), U. S. P.].

Pŭlvis Aromăticus—Pŭlveris Aromătici—Aromatic Powder.—*Dose*, 10–30 grains (0.6–2.0 Gm.) (Formula given under *Cardamomum.*)

Pŭlvis Rhēi Compŏsitus—Pŭlveris Rhēi Compŏsiti—Compound Powder of Rhubarb.—Rhubarb, 25; magnesia, 65; ginger, 10 parts. *Dose*, ½–1 dram (2.0–4.0 Gm.) [30 grains (2 Gm.), U. S. P.].

Sўrupus Zingĭberis—Sўrupi Zingĭberis—Syrup of Ginger.—*Dose*, ½–2 drams (2.0–8.0 Cc.) [4 drams (16 Cc.), U. S. P.].

Tinctūra Zingĭberis—Tinctūræ Zingĭberis—Tincture of Ginger (20 per cent.). —*Dose*, ½–2 fluidrams (2.0–8.0 Cc.) [30 minims (2 Cc.), U. S. P.].

Physiological action and **therapeutics** are almost identical with those of other aromatics. Ginger is especially valuable as a stomachic and carminative, to stimulate the stomach, improve the appetite, and relieve *flatulency* and *colic*. It is a safe and efficient domestic remedy for the relief of *simple diarrhea*. It is also much used as a corrective to modify the taste and action of other medicines.

III. AROMATICS USED FOR THEIR SUPPOSED ANTI-SPASMODIC ACTION ON THE NERVOUS SYSTEM.

Asafœtida—Asafœtidæ—Asafetida. *U. S. P.*

Origin.—A gum-resin obtained from the root of *Ferula fœtida* (Bunge) Regel, and probably other species of *Ferula*, large perennial herbs found in Turkestan, Western Thibet, and Western Afghanistan.

Description and Properties.—Irregular masses composed of whitish tears embedded in a yellowish- or brownish-gray, sticky mass. The tears when hard break with a conchoidal fracture, showing a milk-white color, which changes, on exposure, to pink, and finally to brown. The drug has a persistent alliaceous odor and a bitter, alliaceous, acrid taste. When triturated with water it yields a milk-white emulsion, which becomes yellow upon the addition of ammonia water. It is partly soluble in ether, and at least 60 per cent. of it should dissolve in alcohol.

Dose.—5–8 grains (0.3–0.5 Gm.) [4 grains (2.5 Gm.), U. S. P.].

Official Preparations.

Emŭlsum Asafœtidæ—Emŭlsi Asafœtidæ—Emulsion of Asafetida.—*Dose*, 2–4 fluidrams (7.39–15.0 Cc.) [4 fluidrams (16 Cc.) U. S. P.].

Pĭlulæ Asafœtidæ—Pĭlulas (acc.) **Asafœtidæ—Pills of Asafetida.**—*Dose*, 2 to 5 pills.

Tinctūra Asafœtidæ—Tinctūræ Asafœtidæ—Tincture of Asafetida (20 per cent.).—*Dose*, 10–40 minims (0.6–2.5 Cc.) [15 minims (1 Cc.) U. S. P.].

Camphōra—Camphōræ—Camphor. *U. S. P.*

Definition.—The dextrogyrate modification of the saturated ketone, $C_9H_{16}CO$, obtained from *Cinnamomum camphora* (L.) Nees et Ebermaier, and purified by sublimation.

The camphor laurel is a handsome tree 25 to 30 feet (7.5–9 M.) high, indigenous in Eastern and Southeastern Asia, and cultivated in Italy as an ornamental tree.

Description and Properties.—White, translucent masses, of a tough consistence and crystalline structure, readily pulverizable in the presence of a little alcohol, ether, or chloroform; having a penetrating, characteristic odor and a pungently aromatic taste. Very sparingly soluble in water, but readily soluble in alcohol, ether, chloroform, carbon disulphide, benzin, and in fixed and volatile oils.

When camphor is triturated in about molecular proportions with menthol, thymol, phenol, or chloral hydrate, liquefaction ensues. It melts at 175° C. (347° F.), boils at 204° C. (399.2° F.), and is inflammable, burning with a luminous, smoky flame. On exposure to the air it evaporates more or less rapidly at ordinary temperatures, and when moderately heated it sublimes without leaving a residue.

From camphor may be obtained a number of interesting compounds, such as *camphoric acid*, *cymol*, etc. The drug should be kept in well-closed vessels, in a cool place.

Dose.—2–10 grains (0.12–0.6 Gm.).

Official Preparations.

Āqua Camphŏræ—Āquæ Camphŏræ—Camphor Water (0.8 per cent.).—*Dose*, ½–2 fluidounces (15.0–30.0 Cc.) [2 fluidrams (8 Cc.) U. S. P.].

Linimĕntum Camphōræ—Linimĕnti Camphōræ—Camphor Liniment.—Camphor, 20; cottonseed oil, 80 parts. For external use.

Linimĕntum Sapŏnis—Linimĕnti Sapŏnis—Soap Liniment (4–5 per cent.).—For external use.

Spĭritus Camphŏræ—Spĭritus Camphŏræ—Spirit of Camphor (10 per cent.).—*Dose*, 5–40 minims (0.3–2.9 Cc.) [15 minims (1 Cc.), U. S. P.].

Tinctūra Ōpii Camphorāta—Tinctūræ Ōpii Camphorātæ—Camphorated

Tincture of Opium (0.4 per cent.).—*Dose*, 1–4 fluidrams (4–15 Cc.) [2 fluidrams (8 Cc.), U. S. P.].

Camphŏra Monobromāta — Camphŏræ Monobromātæ — Monobromated Camphor (U. S. P.).—*Definition.*—A substitution compound of camphor, $C_9H_{15}BrCO$.

Origin.—Prepared by heating camphor and bromine, dissolving in benzin, and crystallizing from hot alcohol.

Description and Properties.—Colorless, prismatic needles or scales, of a mild, camphoraceous odor and taste, permanent in the air, unaffected by light, and neutral to litmus-paper. Almost insoluble in water; freely soluble in alcohol, ether, chloroform, hot benzin, and fixed and volatile oils; slightly soluble in glycerin.

Dose.—2–5 grains (0.12–0.3 Gm.) [2 grains (0.125 Gm.), U. S. P.].

Ăcidum Camphŏricum—Ăcidi Camphŏrici—Camphoric Acid (U. S. P.).—*Definition.*—A dibasic organic acid, $C_8H_{14}(COOH)_2$, obtained by the oxidation of camphor.

Origin.—Obtained by the oxidation of camphor through the action of nitric acid.

Description and Properties.—White, acicular crystals, odorless, and of a weak, acid, and slightly astringent taste. Soluble in hot water, alcohol, ether, and fatty oils; almost insoluble in cold water.

Dose.—10–30 grains (0.6–2.0 Gm.) [15 grains (1 Gm.), U. S. P.].

Valeriāna—Valeriānæ—Valerian. *U. S. P.*

Origin.—The dried rhizome and roots of *Valeriana officinalis* L., an herbaceous perennial 2 to 4 feet (0.6–1.2 M.) high, a native of Europe, and cultivated to some extent in New England and New York.

Description and Properties.—The rhizome varies in length between ½ and 1¼ inches (1–3 Cm.), and has nearly an equal diameter, thick, upright, subglobular or obconical, truncate at both ends, brown or yellowish-brown, internally whitish or pale-brownish, with a narrow circle of white wood under the thin bark. Roots numerous, slender, brittle, brown, with a thick bark and slender, ligneous cord. Odor peculiar, becoming stronger and unpleasant on keeping; taste camphoraceous and somewhat bitter.

Valerian contains *valerianic* and other acids and a volatile oil.

Dose.—15–60 grains (1.0–4.0 Gm.) [30 grains (2 Gm.), U. S. P.].

Official Preparations.

Fluidextrăctum Valeriānæ—Fluidextrăcti Valeriānæ—Fluidextract of Valerian.—*Dose*, 15–60 minims (1.0–4.0 Cc.) [30 minims (2 Cc.), U. S. P.].

Tinctūra Valeriānæ—Tinctūræ Valeriānæ—Tincture of Valerian (20 per cent.).—*Dose*, 1–2 fluidrams (4.0–8.0 Cc.) [1 fluidram (4 Cc.), U. S. P.].

Tinctūra Valeriānæ Ammoniāta—Tinctūræ Valeriānæ Ammoniātæ—Ammoniated Tincture of Valerian (20 per cent.).—*Dose*, 30–60 minims (2.0–4.0 Cc.) [30 minims (2 Cc.), U. S. P.].

Ammŏnii Valĕras—Ammŏnii Valerātis—Ammonium Valerate (U. S. P.).—*Definition.*—It should contain not less than 98 per cent. of pure ammonium valerate, $C_4H_9COONH_4$.

Origin.—Obtained by saturating valerianic acid with gaseous ammonia and crystallizing.

Description and Properties.—Colorless or white quadrangular plates, emitting the odor of valerianic acid; of a sharp and sweetish taste; deliquescent in moist air. Very soluble in water and in alcohol. Ammonium valerianate should be kept in well-stoppered bottles.

Dose.—2–10 grains (0.12–6 Gm.), [7½ grains (5 Gm.) U. S. P.].

Zĭnci Valĕras—Zĭnci Valerātis—Zinc Valerate (U. S. P.).—*Definition.*—It should contain not less than 99 per cent. of pure zinc valerate $(C_4H_9COO_2)ZN + 2H_2O$.

Origin.—Obtained by evaporating hot solutions of zinc sulphate and sodium valerianate, the zinc valerianate crystallizing out.

Description and Properties.—White, pearly scales, having the odor of valerianic acid and a sweetish, astringent, and metallic taste. On exposure to air it slowly loses valerianic acid. Soluble in about 100 parts of water and in 40 parts of acohol. It should be kept in small, well-stoppered bottles.

Dose.—½–3 grains (0.03–0.2 Gm.) [2 grains (1.25 Gm.), U. S. P.].

Physiological Action.—*Externally and Locally.*—The only member of this group having any special local action is CAMPHOR. This drug has an anesthetic effect upon the unbroken skin, but in a concentrated state is very irritating to mucous membranes, and may even produce inflammation and sloughing. CAMPHOR is also a powerful parasiticide.

Digestive System.—In medicinal doses antispasmodics stimulate the digestion and augment the secretions from the gastro-intestinal tract. They also stimulate peristalsis, and are active carminatives and calmatives to the digestive tract. ASAFETIDA is the most laxative of all.

Large doses of any antispasmodic cause nausea, vomiting, and purging, CAMPHOR being the most irritant, and in toxic doses acting as an irritant poison.

Circulatory System.—In medicinal doses the antispasmodics increase the force of the heart and elevate arterial tension.

Nervous System.—It is probably upon the nervous system that these drugs exert their most potent action. They are all stimulants to the cerebrum.

The antispasmodics, it will be seen, appear to exert a calmative influence upon certain nerve-centers, allaying nervous excitement and muscular spasm. They produce a gentle, exhilarating effect upon the brain, and diffuse a feeling of warmth in the system. It is claimed that they also possess mildly aphrodisiac properties. Excessive doses, on the other hand, may occasion delirium, even merging in maniacal excitement, this being particularly true of CAMPHOR, toxic doses of which drug, in the monobromated form, cause muscular weakness, passing into paralysis, followed by stupor and collapse. VALERIAN may occasion formication of the hands and feet and a condition of mental depression.

Respiratory System.—The antispasmodics are all respiratory stimulants and stimulant expectorants. Large doses of MONOBROMATED CAMPHOR depress respiration.

Absorption and Elimination.—These drugs are readily absorbed from the stomach or rectum, and are eliminated by the intestinal tract, kidneys, lungs, skin, and mucous membranes generally, stimulating the glands in these structures, and, in the case of ASAFETIDA and VALERIAN, imparting the characteristic odor of these drugs to the excretions.

Temperature.—Unaffected except by MONOBROMATED CAMPHOR, which in large doses acts as a depressant.

Uterus.—The menstrual flow and sexual appetite are increased at first; continued dosage, however, has a depressing effect upon the generative functions, CAMPHOR perhaps being the most active in large doses.

ASAFETIDA exerts the greatest influence on menstruation, while CAMPHOR has the most marked effect upon the general circulation.

It is said that the sexual passion of cats is extraordinarily excited by valerian, probably because of its odor.

Untoward Action.—CAMPHOR may occasion mental confusion, headache, vertigo, dryness of the mouth and thirst, flushing of the face, clammy perspiration, disturbances of digestion, and strangury. Musk produces similar untoward manifestations, with a sense of pressure in the eye-sockets and marked sexual excitement. The symptoms caused by VALERIAN are very much the same, although, as in the untoward action of ASAFETIDA, there is more disturbance of the gastro-intestinal tract, such as nausea, borborygmi, diarrhea, and colicky pains. Barbier noted visual hallucinations in a person treated with VALERIAN.

Poisoning.—The symptoms of poisoning resemble the untoward action, save that the effects may be more marked, with greater irritation of the intestinal tract and more pronounced cerebral disturbance.

Treatment of Poisoning.—Coffee and the arterial sedatives antagonize the action of CAMPHOR. The patient should be treated symptomatically; emetics or the stomach-pump should be employed, and measures taken to favor elimination. Excessive nervous manifestations may be controlled by opium or the bromides.

Therapeutics.—*Externally and Locally.*—The only member of the present group used locally is CAMPHOR, its anesthetic and antipruritic properties rendering it of great value in the treatment of diseases of the skin. "Anderson's powder," composed of pulverized camphor, starch, and zinc oxide, is a very soothing and efficient dusting-powder in *erythema*, *erythematous eczema*, and *urticaria*. "Camphor-ice" and ointments of camphor, alone or combined with salicylic acid, are used for "*chapped hands*," *ulcers*, etc.

Various inhalants and powders containing camphor have been successfully employed in the treatment of *ozena*, *acute coryza*, and *laryngitis*. SUPPOSITORIES OF CAMPHOR afford great relief in cases of *chordee*, while the CAMPHOR LINIMENT is a household remedy for *sprains*, *bruises*, *chilblains*, etc.

CAMPHOR CHLORAL makes an efficient local application in *neuralgia*, and the CAMPHO-PHENIQUE is an excellent antiseptic, when mixed with oil being an efficient dressing for *wounds*.

Internally.—The disagreeable odor and taste of many of the antispasmodics—notably asafetida, valerian, and musk—greatly limit their use. ASAFETIDA is an exceedingly valuable stomachic tonic, and singularly beneficial in the *atonic dyspepsia* and *constipation* of nervous and anemic women. It stimulates the appetite and digestion, acts as a laxative, and allays much of the nervousness and depression from which these patients so frequently suffer.

ASAFETIDA is a peculiarly potent remedy in relieving *paroxysms of hysteria* and there is probably no more effective agent for the alleviation of *flatulent colic* of infants and various *infantile convulsions*. It is here given in enemata.

Chronic bronchitis and *bronchorrhea*, especially when attended with spasmodic dyspnea, are very favorably influenced by this remedy. Its antispasmodic action renders asafetida of considerable

value in *whooping-cough* and the *sympathetic cough of mothers*. The drug has been highly recommended in *chorea* occurring in young girls about the age of puberty, who are weak, anemic, and suffering from menstrual irregularities. The emulsion of asafetida, used as an enema, often affords prompt and complete relief in the *tympanitis of typhoid fever*.

CAMPHOR is a remarkably efficient anodyne, antispasmodic, and carminative in *flatulent colic*, *diarrhea of infants*, and the *diarrhea of the aged* produced by relaxation of the bowels. For many years camphor has been considered a valuable remedy in the diarrhea ushering in an attack of *Asiatic cholera*.

The various spasmodic and hysteric disorders for which asafetida is recommended are also greatly benefited by camphor. It is, moreover, a serviceable stimulant expectorant and a potent remedy, especially MONOBROMATED CAMPHOR, to allay *sexual excitement* and for the relief of *chordee*. It has likewise proved efficacious in *spermatorrhea*.

Dysmenorrhea and the *after-pains* of labor are greatly relieved by camphor, either alone or combined, with morphine. The drug has been used extensively as a cardiac stimulant and to allay the delirium and restlessness of *typhoid*, *typhus*, and *exanthematous fevers*.

CAMPHORIC ACID is an efficient remedy in checking the *night-sweats* of *phthisis* and *excessive perspiration* in *acute rheumatism*. It is recommended by Wood in *eneuresis* and *spermatorrhea*. While not so efficient as camphor or monobromated camphor in spasmodic and hysteric disorders, it has proved of some benefit in these conditions.

Camphoric acid in from 1 to 2 per cent. solution is useful in the treatment of *acute pharyngitis* and *acute coryza*, being employed in the form of a gargle or spray.

Camphoric acid has been used internally to acidify ammoniacal urine in *cystitis*.

VALERIAN has been employed for the same class of disorders as those treated with asafetida, but seems to be superior to the latter in mitigating the *hysteric manifestations* and *vasomotor disturbances* occurring at the *menopause*.

The *hypochondriasis* of feeble and morbidly sensitive girls and women is occasionally relieved by this remedy. *Nervous headache* and *vertigo* are often promptly relieved by valerian or the ammonium valerate.

Valerian has been favorably recommended in both *diabetes insipidus* and *diabetes mellitus*.

Contraindications.—There are no special contraindications to the use of antispasmodics other than in acute inflammations of the gastro-intestinal tract, when camphor should not be employed.

Administration.—Any of the preparations of the various members of this group may be used. Asafetida and camphor in substance should always be given in the form of pills or capsules. Camphoric acid is best administered in capsules.

ANTIPYRETICS AND ANTIPYRETIC ANALGESICS.

In the attempt to make an artificial quinine when it was pointed out that that alkaloid was a derivative of quinolene, a host of new bodies which have become of immense importance in modern therapeutics, has been brought into existence. A number of these bodies will be discussed in this chapter, and for purposes of convenience they have been grouped as follows: I. Quinolene derivatives, with the general formula C_9N_7N. Quinine, euquinine, analgene, kairoline, thalline, cupreine, quinaphtol. II. Pyrrhol derivatives, C_4H_5N, $C_3H_4N_2$, antipyrine, tolypyrine, tolysal, anilipyrine, pyramidon, and other antipyrine relatives. III. Hydrazine derivatives: phenylhydrazine, pyrodine, antithermine; and IV. Aniline derivatives: aniline, acetanilid, exalgine, euphorine, thermodine, neurodine, phenetidine, phenacetine, triphenine, lactophenine, citrophen or, apolysine, malakine, phenosal, cosapine, phesin, phenocol, eupyrine, pyrantine, etc.

The chemical relations of these will be pointed out later. It is of importance to remember that, although a large number of substances are here printed, many of them have no real excuse for being. Thus, in the first group, the quinolines proper, quinine is practically the only one worth mentioning, and in the second group antipyrine is the only member of real importance.

As for the hydrazines they are not a trustworthy series of drugs. They depress temperature very markedly, it is true, but they do so at the expense of a profound hemolytic action in the blood.

Concerning the aniline groups, it contains many important drugs, principally acetanilid and phenacetine, but there are many others of marked therapeutic value. This group falls naturally into two series. In the one are derivatives of *phenylamine*, $N \begin{cases} -H \\ -H \\ -C_6H_5 \end{cases}$, or ammonias in which one hydrogen is replaced by the phenyl radicle. In *acetanilid* another hydrogen is replaced by the acetyl group, or $N \begin{cases} -H \\ -C_2H_3O \\ -C_6H_5 \end{cases}$, and in *exalgine* the third hydrogen is replaced by a methyl group $N, \begin{cases} -CH_3 \\ -C_2H_3O \\ -C_6H_5 \end{cases}$. The second series in this aniline group is termed the phenetidines, they are compounds of para-

amido phenol, $C_6H_4\langle{}^{OH}_{NH_2}$, in which a hydroxyl in the dioxybenezol nucleus is replaced by an amido group. If an acetyl group is introduced in the hydrogen of the hydroxyl, $C_6H_4\langle{}^{OC_2H_3O}_{NH_2}$, phenetidin is the result, if an ethyl and an acetyl group are introduced, $C_6H_4\langle{}^{OC_2H_5}_{NHC_2H_3O}$, *phenacetine* is produced, while a methyl instead of the ethyl gives $C_6H_4\langle{}^{OCH_3}_{NHC_2H_3O}$, *methacetin.* Other substitutions are numerous in these bodies, but these are the most fundamental.

The anilines possess to a certain extent the same drawbacks as the hydrazines, they are destructive to the blood, but usually only in larger doses. Only continued experience will teach which are the most to be trusted.

I. QUINOLIN GROUP.

Cinchōna—Cinchōnæ—Cinchona. *U. S. P.*

Definition.—The dried bark of *Cinchona Ledgeriana* Moene, *Cinchona Calisaya* Weddell, *Cinchona officinalis* L., and of hybrids of these with other species of *Cinchona.* It should yield not less than 5 per cent. of total anhydrous cinchona alkaloids, and at least 4 per cent. of anhydrous ether-soluble alkaloids.

Origin.—The genus *Cinchona* as at present constituted consists of from thirty-one to thirty-six species, all of which are native to South America. The habitat of the three follows the eastern slope of the Andes, beginning in Bolivia and extending through Peru. From about 2° south latitude in Ecuador it occupies also the eastern slope of the Western Cordilleras, until by two narrow belts it enters the highlands of New Granada, whence it spreads northeast and northward into Venezuela, reaching the vicinity of Caracas and the Caribbean Sea. Owing to the great number of hybrids the delimitation of the various species of cinchona is, at the present time, almost an impossible task.

The climate in which the most valuable species are found is, according to Karsten (1858), characterized by a rainy season lasting for nine months, heavy rains falling principally during the night, alternating with sunshine and fog during the day. During the remaining three months of the year the nightly temperature frequently sinks below freezing-point, in the day-time, however, reaching 25° C. (77° F.), producing dense fogs.

The Cinchonas are evergreen trees or shrubs, the most valuable species attaining a height of from 40 to 80 feet (12 to 24 M.). They are not met with in the valleys, but are found at altitudes varying from 330 feet (100 M.) to 11,500 feet (3500 M.). According to Weddell, the most valuable species grow at an altitude of 5300 to 7900 feet (1600 to 2400 M.). All the species are found in the primeval forests, either singly or in collections of a few specimens. The tree is cultivated in British Sikkim, Ceylon, Java, and Jamaica. It is also cultivated in South America, its original home.

Description and Properties.—In quills or in curved pieces, varying in length, and usually $\frac{1}{12}$ or $\frac{1}{8}$ inch (2 or 3 Mm.), or sometimes $\frac{1}{5}$ inch (5 Mm.) thick; the outer surface covered with a gray or brownish-gray cork, usually slightly wrinkled, marked with transverse and also intersecting longitudinal fissures (*C. Calisaya*), and sometimes with scattered warts and slight longitudinal ridges; inner surface light cinnamon-brown, very highly striate; fracture of the outer layer short and granular, finely fibrous in the inner layer; powder light- or yellowish-brown; odor slight, somewhat aromatic; taste bitter and somewhat astringent.

Cinchōna Rūbra—Cinchōnæ Rūbræ—Red Cinchona. *U. S. P.*

Origin.—The dried bark of *Cinchona succirubra* Pavon, and of its hybrids containing not less than 5 per cent. of its anhydrous cinchona alkaloids.

Description and Properties.—In quills or in curved pieces, varying in length, and from $\frac{1}{12}$ to $\frac{1}{6}$ or $\frac{1}{5}$ inch (2 to 4 or 5 Mm.) thick; the outer surface covered with a grayish-brown cork, more or less rough from warts and longitudinal warty ridges, and few, mostly short, transverse fissures; inner surface more or less deep reddish-brown and distinctly striate; fracture short-fibrous in the inner layer; powder reddish-brown; odor slight; taste bitter and astringent.

Among the various alkaloids found in cinchona the following are the most important: *Quinine, quinidine, cinchonine,* and *cinchonidine,* the medicinal value of the bark depending almost exclusively upon the alkaloid *quinine.*

Other less important ingredients are kinic and kinovic acids, kinovin, cinchotannic acid, cinchona-red, and a minute quantity of a butyraceous, volatile oil. The ash amounts to between 1 and 2 per cent., consisting chiefly of the carbonates of calcium and potassium.

Dose of powdered cinchona, 15–60 grains (1.0–4.0 Gm.) [15 grains (1 Gm.) U. S. P.].

Official Preparations of Cinchona.

Fluidextrăctum Cinchōnæ—Fluidextrăcti Cinchōnæ—Fluidextract of Cinchona.—*Dose,* 10–60 minims (0.6–4.0 Cc.) [15 minims (1 Cc.), U. S. P.].

Tinctūra Cinchōnæ—Tinctūræ Cinchōnæ—Tincture of Cinchona (20 per cent.).—*Dose,* 1–2 fluidrams (4.0–8.0 Cc.) [1 fluidram (4 Cc.), U. S. P.].

Official Preparation of Cinchona Rubra.

Tinctūra Cinchōnæ Compŏsita—Tinctūræ Cinchōnæ Compŏsitæ—Compound Tincture of Cinchona (10 per cent. with bitter orange peel 8 per cent., and serpentaria 2 per cent.).—*Dose,* 1–4 fluidrams (4.0–15.0 Cc.) [1 dram (4 Cc.), U. S. P.].

Official Alkaloids and Salts.

Cinchonidīnæ Sŭlphas—Cinchonidīnæ Sulphātis—Cinchonidine Sulphate.—*Description and Properties.*—White, silky, acicular crystals, without odor, and having a very bitter taste; slightly efflorescent on exposure to air. Soluble in 63 parts of water and in 72 parts of alcohol at 25° C.

Dose, 10–30 grains (0.6–2.0 Gm.) [4 grains (0.25 Gm.), U. S. P.].

Cinchonīnæ Sŭlphas—Cinchonīnæ Sulphātis—Cinchonine Sulphate.—*Description and Properties.*—Hard, white, lustrous, prismatic crystals, without odor and of a very bitter taste; permanent in the air; soluble in 58 parts of water and in 10 parts of alcohol at 25° C.

Dose, 5–30 grains (0.3–2.0 Gm.) [4 grains (25 Gm.), U. S. P.].

Quinīna—Quinīnæ—Quinine.—*Description and Properties.*—A white, flaky, amorphous or crystalline powder, odorless, and having a very bitter taste; permanent in the air; soluble in 1750 parts of water and in 0.6 part of alcohol at 25° C. Quinine should be kept in well-stoppered bottles, in a dark place.

Dose, 1–60 grains (0.06–4.0 Gm.) [4 grains (0.25 Gm.), U. S. P.].

Quinīnæ Bisŭlphas—Quinīnæ Bisulphātis—Quinine Bisulphate.—*Description and Properties.*—Colorless, transparent, or whitish orthorhombic crystals or small needles; odorless and having a very bitter taste; efflorescent on exposure to the air. Soluble in 8.5 parts of water and in 18 parts of alcohol at 25° C. It should be kept in well-stoppered bottles, in a dark place.

Dose, 1–15 grains (0.06–1.0 Gm.) [4 grains (0.25 Gm.), U. S. P.].

Quinīnæ Hydrobromīdum—Quinīnæ Hydrobromīdi—Quinine Hydrobromide.—*Description and Properties.*—White, light, silky needles; odorless and of a very bitter taste. The salt is liable to lose water on exposure to warm or dry air. Soluble in 40 parts of water and in 0.67 part of alcohol at 25° C. It should be kept in well-stoppered bottles, in a dark place.

Dose.—1–20 grains (0.06–1.3 Gm.) [4 grains (0.25 Gm.), U. S. P.].

Quininæ Hydrochlōridum—Quininæ Hydrochloridi—Quinine Hydrochloride.—*Description and Properties.*—White, silky, light and fine needle-shaped crystals, odorless, and having a very bitter taste. The salt is liable to lose water on exposure to warm air. Soluble in 18 parts of water and in 0.6 part of alcohol at 25° C. Quinine hydrochlorate should be kept in well-stoppered bottles, in a dark place.

Dose.—1–15 grains (0.06–1.0 Gm.) [4 grains (0.25 Gm.), U. S. P.].

Quininæ Sŭlphas—Quininæ Sulphātis—Quinine Sulphate.—*Description and Properties.*—White, silky, light, and fine needle-shaped crystals, fragile and somewhat flexible, making a very light and easily compressible mass, lustrous from superficial efflorescence after being for some time exposed to the air; odorless and having a persistent, very bitter taste. The salt is liable to lose water on exposure to warm air, to absorb moisture in damp air, and to become colored by exposure to light. Soluble in 720 parts of water and in 86 parts of alcohol, also in 36 parts of glycerin and in about 400 parts of chloroform, and freely soluble in dilute acids at 25° C. It should be kept in well-stoppered bottles, in a dark place.

Dose.—1–60 grains (0.06–4.0 Gm.) [4 grains (0.25 Gm.), U. S. P.].

Quininæ Salĭcylas—Quininæ Salicylātis—Quinine Salicylate (U. S. P.).—*Definition.*—The salicylate, $2C_{20}H_{24}N_2O_2.C_7H_6O_3 + H_2O$, of the alkaloid quinine.

Description and Properties.—Colorless needles, permanent in air, but acquiring a pinkish tinge after a time. Soluble in cold water (1 : 77), somewhat more so in warm (1 : 35), in alcohol (1 : 11), and in glycerin (1 : 16) at 25° C.

It contains 68.79 per cent. quinine (the bisulphate contains 59.1 per cent. quinine, the hydrobromide 76.6 per cent., the hydrochloride 81.8 per cent., the sulphate 74.3 per cent.). The bisulphate is soluble in 8.5 parts of water, the hydrobromide in 40 parts, the hydrochloride in 18 parts, the sulphate in 720 parts; the official alkaloid (containing 3 molecules of water) is soluble in 1550 parts of water.

Dose.—Average dose: 4 grains (0.250 Gm. = 250 milligrammes), U. S. P.

Unofficial Alkaloids, Salts, and Other Quinolines.

Chinoidinum—Chinoidini—Chinoidine.—*Origin.*—Obtained from the mother-liquor in the preparation of quinine sulphate, cinchonine, and the other alkaloids of cinchona.

Description and Properties.—Cylindrical rolls or masses, of a more or less deep-brown or black color and a resin-like appearance. It has but a slight taste, being faintly bitter on mastication. Almost insoluble in water; freely soluble in alcohol.

Dose.—3–30 grains (0.2–2.0 Gm.).

Cinchonidinæ Salĭcylas—Cinchonidinæ Salicylātis—Cinchonidine Salicylate.—*Dose,* 2–10 grains (0.12–0.6 Gm.).

Cinchonina Iodosulphas—Cinchoninæ Iodosulphatis—Cinchonine Iodosulphate (ANTISEPTOL) (50 per cent. of iodine).—*Description and Properties.*—A light powder of a reddish-brown color; insoluble in water, but soluble in alcohol. Used principally as a substitute for iodoform.

Chīnolin—Chīnolin—Chinolin (QUINOLIN).—*Origin.*—Prepared from cinchonine or quinine by distillation, or obtained synthetically.

Description and Properties.—A colorless liquid, with an aromatic, pungent odor; slightly soluble in water, freely soluble in alcohol.

Quinoline itself was at one time used as a substitute for quinine to reduce temperature, but it induces collapse and has been discarded.

Analgine, analgen, ethoxyacetylamidoquinolin, is occasionally used. It is broken down into benzoic acid, quinoline, and an orange-colored antiseptic derivative, thus staining the urine red. It is of some service in acute articular rheumatism in doses of 15–30 grains (1.0–2.0 Gm.).

Dose.—3–10 minims (0.18–0.6 Cc.).

Chīnolin Tārtras—Chīnolin Tartrātis—Chinolin Tartrate.—Soluble in 70 or 80 parts of water. *Dose,* 5–15 grains (0.3–1.0 Gm.).

Quinetum—Quineti—Quinetum.—A mixture of the alkaloids precipitated by an alkali. *Dose,* 1–60 grains (0.06–4.0 Gm.).

Quininæ Hydrochlōras Carbamidāta—Quininæ Hydrochlorātis Carbamidātæ.—Double salt of quinine and urea. Soluble in water. *Dose,* 1–10 grains (0.06–0.6 Gm.). Usually employed hypodermically.

Kāirine ($C_9H_9(OH)N - C_2H_5$) and **Thalline** ($C_9H_9(OCH_3)NH$) were at one

time extensively used as antipyretics and analgesics, but they have been found very depressing, and after the initial fall in temperature it has been found to rise again.

Eûquinine, an ethyl carbonate of quinine, has an action precisely similar to that of quinine as it breaks down into that body. It has no advantages, save those of taste and more ready solubility.

The name cinchona given to Peruvian bark was accorded in honor of the countess of Chinchon, cured of tertian fever by the use of the drug, as early as the seventeenth century, the Spanish conquerors of the country having discerned the curative properties of the plant which scientific investigation has rendered invaluable as a therapeutic agent.

About the middle of the seventeenth century a large quantity of the bark received from America reawakened a discussion, and finally a council of Jesuits held at Rome approved a distribution of the drug—called therefrom "Jesuits' bark." It quickly found its way to other parts of the Continent and to England; yet still the opposition to its use was pronounced, and it was only when an English quack doctor succeeded in effecting cures among persons of rank by an employment of the drug that its services became general in malarial and typhoid fevers, as well as in various other diseases.

The discovery of the active principles of cinchona, crudely established by Duncan in 1803, was perfected by Pelletier and Caventou in 1820 by the preparations of quinine and cinchonine. In 1833 quinine became partially known, being completely isolated as an active principle in 1852, quinine and cinchonine having been employed since 1820–21.

Until the researches of Marchiafava, Celli, Laveran, Golgi, and others had disclosed the true etiology of malaria, quinine was used empirically in malarial diseases, its precise action being unknown. Its efficacy is now ascertained to be due to its power of destroying the plasmodia of malaria. In addition to this action, which renders the drug of the greatest value in malarial diseases, quinine possesses many other important properties, which are here considered.

Antagonists and Incompatibles.—Agents promoting waste—such as the salts of mercury, iodine, copper, zinc, lead—are therapeutically antagonistic to cinchona. The cerebral effects of quinine are antagonized by morphine, while atropine opposes its action upon the nervous and circulatory systems, as well as its antipyretic powers.

The incompatibles are free tannic acid, alkalies and alkaline earths, and iodine. Fowler's solution is incompatible with infusion and decoction of cinchona.

Synergists.—All agents promoting constructive metamorphosis. The antipyretic action of quinine is enhanced by the antipyretics, many of the aromatics and antiseptics. Its antiperiodic action is aided by arsenic, phenol, creosote, and many of the aromatics.

Physiological Action.—*Externally and Locally.*—The drug is a

mild germicide, preventing putrefaction and fermentation by its destructive influence upon fungi and infusoria, a solution of 1 : 250 being sufficient for this purpose, while 1 : 500 is fatal to certain micro-organisms, and even so weak a solution as 1 : 1000 suffices to destroy some infusoria.

Quinine is essentially a protoplasm-poison. It affects lower animals and plants, interferes, when present, with the normal processes of reproduction, affects the blood-cells, and, moreover, has a peculiar action in diminishing the activity of many of the unorganized ferments.

Upon the unbroken skin it has little effect, other than to produce occasionally a slight roughening of the surface. To raw surfaces, however, and to mucous membranes it is irritant.

Internally.—Digestive System.—Its action resembles that of vegetable bitters, augmenting the secretions from the salivary and gastro-intestinal glands, stimulating peristalsis, and increasing the blood-supply to the stomach. Under moderate doses, therefore, the appetite and digestion are improved. Large dosage disturbs digestion, occasioning nausea, with, possibly, vomiting and diarrhea. The acidity of the stomach is said to be increased by quinine sulphate.

Circulatory System.—Small doses increase the force and frequency of the heart's action, excessive doses slowing and weakening it, and, frequently in children, causing an intermittent pulse. Toxic doses paralyze the heart, arresting it in diastole. It is uncertain whether or not these effects are due to an exclusive action on the cardiac muscle. It is evident, though, that small doses elevate, and large doses depress, arterial tension.

Quinine in a remarkable manner affects the constituents of the blood. The ameboid movements of the white blood-corpuscles are arrested, preventing their migration through the capillary walls in inflammation, while their number is diminished by full doses of the drug both in health and in inflammatory conditions. The red corpuscles are relatively increased in number, at least in proportion to the white corpuscles, the size of the former being diminished in febrile conditions.

Quinine retards or impairs all the oxidizing powers of the body, and materially lessens the oxygen-carrying capacity of the red corpuscles. This is shown in the diminished metabolism of the body.

Nervous System.—Small doses stimulate the cerebrum. Large doses occasion cerebral congestion, with a sensation of dizziness, fulness in the head, and other symptoms described at length under "Cinchonism."

In mammals there is a transient stimulation of the spinal cord, followed by a depression. In lower animals, notably the frog, there is a primary increase in the reflex irritability, which subsequently is followed by depression, perhaps an index of the action of the drug on the protoplasm of the ganglionic cells. Muscular

action is profoundly altered, quinine acting as a poison. Its action on sensory and motor nerves is not marked, and depressing effects on muscular contraction, formerly attributed to its action on the terminal end-plates of the motor nerves, have, of late years, been attributed to its action upon the muscle protoplasm itself.

Respiratory System.—Quinine exerts but little influence upon the respiration, small doses slightly increasing and large doses depressing the respiratory movements; death being due to respiratory paralysis, at least in the lower animals. Such paralysis is usually accompanied by paralysis of the heart and vagus. When toxic doses of quinine are thrown directly into the circulation, paralysis of the heart may be primary.

Absorption and Elimination.—The drug is quite rapidly absorbed from the alimentary canal. While its presence may be detected in the urine within fifteen minutes after the ingestion of a full dose, many hours, or even days, may elapse before the drug is finally excreted.

Some of the drug undergoes a change in the system, especially in the liver, and it may be detected in the urine as quinine and various isomeric modifications of it. While chiefly eliminated by the kidneys, it may escape from the system by other channels, having been found in the milk, sweat, saliva, tears, bile, and in dropsical effusions. Fully 90 per cent. has been recovered in the urine.

The excretion of uric acid, urea, and other nitrogenous material is considerably diminished under the use of quinine. Products by oxidation other than those derived from the nitrogenous elements are not markedly affected, hence it is probable that quinine only hinders the breaking down of proteids.

Temperature.—In health the temperature is unaffected by quinine, but in febrile conditions, particularly in malarial fever, the drug acts as a powerful antipyretic. Its antipyretic action is due, in all probability, to its action on the tissues directly. It also causes diaphoresis. Its action in malaria is naturally as a parasiticide. Many clinicians believe that it is destructive to bacteria as well as protozoa.

Eye.—There have been recorded several cases of amblyopia and of quinine amaurosis, with transitory blindness, color-blindness, wide dilatation of pupil—irresponsive to light, but responding to accommodation effort—pallor of the optic disks, with extreme diminution of both retinal veins and arteries and contraction of the visual field.

Quinine amaurosis, however, is probably very rare, but a limited number of cases being recorded, although Rogers believes that "incomplete ocular cinchonism" is of quite frequent occurrence.

Uterus.—After the inception of labor quinine seems frequently to stimulate the uterine contractions. It also increases a scanty menstrual flow. There appears to be no authoritative evidence that quinine is an abortifacient.

Untoward Action.—Besides the symptoms of cinchonism from which some persons suffer after the ingestion of a small dose, there are often occasioned various eruptions of the skin, often accompanied by marked pruritus, the eruption produced by the drug at times strongly resembling scarlatina.

Peculiar disturbances of vision and impaired hearing not infrequently attend the administration of quinine. Many patients cannot take it because of the incessant buzzing it causes. There have been recorded cases of renal and vesical irritation, varying in intensity, following the use of the drug. The administration of the salts of quinine in pill form is often followed by gastro-intestinal catarrh. The drug has also been known to occasion epistaxis and hemoptysis.

Poisoning.—Excessive doses of quinine produce a series of symptoms collectively termed *cinchonism.* They are—a feeling of fulness in the head, ringing or buzzing in the ears, varying degrees of deafness, headache, with possibly delirium, disturbances of vision, vertigo, and muscular weakness. In severe poisoning there is nausea and vomiting, swelling of the mucous membrane, bleeding from the nose, may be from the lungs, eruptions, albumin, and blood in the urine, with somnolence, coma, small rapid pulse, respiratory failure, and death. The lethal dose is difficult to determine. 1 to 2 Gm. have been fatal in children; doses of 30 Gm. have been taken without serious inconvenience.

Treatment of Poisoning.—Potassium bromide and hydrobromic acid are the best agents to relieve the symptoms of cinchonism, full doses of the latter given with quinine being said to prevent untoward results.

Should the dose be sufficient to depress the heart and respiration in a marked degree, cardiac and respiratory stimulants would be indicated.

Therapeutics.—*Externally and Locally.*—Powdered cinchona bark is an ingredient of many tooth-powders. Quinine also enters into the composition of many "hair tonics," and is highly recommended by some physicians in the treatment of *alopecia.*

The drug has been employed with varying success in many diseases of the nose and throat, such as *hay fever*, *whooping-cough*, *ozena*, *tonsillitis*, etc.

Ledetsch has highly recommended quinine bisulphate, 1 part to 100 parts of water and glycerin, as an injection in *gonorrhea.* The drug has been used with tincture of ferric chloride as a paint to prevent the spread of *erysipelas.* A 2 per cent. solution has proved an efficient remedy in *cystitis*, effectually preventing the decomposition of the urine.

Internally.—Undoubtedly the principal use of quinine is in the treatment of *malarial diseases.* When we realize that quinine in 1 part to 20,000 is sometimes destructive of the plasmodium malariæ, it is readily understood why the drug should be so efficient as an antimalarial remedy.

Quinine is one of the most powerful antiperiodics, being of more or less value in many diseased conditions characterized by periodical exacerbations. All forms of *malarial fever* usually yield to the proper use of quinine. It seems to be somewhat efficient as a prophylactic.

From a practical point of view it is fairly well established that at certain phases of development the malarial parasite offers less resistance to the action of quinine than at others. Thus, in the early stages of the parasite's development, particularly while in the blood cell, the resistance to quinine is very marked; parasitic forms, which are free. swimming in the blood-serum, offer less resistance. The best results are obtained from quinine when administered during the stage of fever or in the period immediately preceding. Early doses of quinine check the development of the second stage, and prevent, in part at least, the segmentation of the parasite. The practical point to be gained from the recent studies is that quinine given in the period preceding the fever and during fever is most effective in the cure of the non-pernicious types of the disease. As it take from two to four hours for quinine to saturate the plasma, this amount of time should be allowed and a dose of from 10 to 15 grains, given two to three hours before the chill which is thought to record the breaking free of the parasites from the red blood-cells.

Many periodical affections due occasionally to malarial organisms are peculiarly amenable to this drug, among these disorders being various *neuralgias*, *headache*, *asthma*, *hay fever*, *chorea*, *jaundice*, *diarrhea*, *dysentery*, etc.

It is particularly beneficial in cases of prolonged suppuration, such as *pulmonary phthisis*, *fistulous discharges*, *septicemia*, *pyemia*, *puerperal fever*, etc. It favorably influences the formative stages of acute inflammations, as in the beginning of *endocarditis*, *pneumonia*, *pleurisy*, etc.

As a tonic or restorative during the course of febrile diseases, as well as in convalescence, quinine is highly efficient. Its action upon the gastro-intestinal tract renders it valuable in many forms of *dyspepsia*, especially the atonic variety. In these cases, where anemia is present, the drug may be advantageously combined with iron and nux vomica.

Quinine is but little used now as a pure antipyretic. Its antipyretic influence is consequently more marked in *intermittent fever*. It is of value also in *typhoid*, but less as an antipyretic than as a general tonic.

It is of decided value in the *yeasty vomiting* produced by the *sarcina ventriculi*, and equally beneficial in *impetigo;* while *acne* and *ecthyma*, when occasioned by reduced vitality and impaired nutrition, are greatly benefited by its internal use.

Quinine is serviceable in stimulating the *uterine contractions during labor* and increasing the menstrual discharge in *amenorrhea*.

Contraindications.—The drug is contraindicated in acute in-

flammations of the genito-urinary and gastro-intestinal tract, in acute or subacute inflammations of the middle ear, and in meningitis and cerebritis. It should not be given to infants suffering from eczema, nor to persons having a marked idiosyncrasy against the drug.

Administration.—Because of its intensely bitter and disagreeable taste quinine should not be given in solution. It may be suspended in syrup of yerba santa or in the aromatic elixir of licorice, which disguises the taste quite effectually, and for children is preferable, as a method of administration, to capsules or pills. In the case of adults the drug should be given in gelatin capsules or in the form of gelatin- or sugar-coated pills.

The tannate of quinine is comparatively tasteless, and may be incorporated with chocolate in the form of lozenges, thus being readily taken by children.

The drug may be also administered in a suppository by the rectum or incorporated in lard and rubbed into the skin, preferably in the axillæ and the inner side of the thighs or over the abdomen. It has been employed to some extent hypodermically, the quinine hydrobromate and bisulphate being the salts preferred for this purpose. Injections should be made in the buttocks, and very slowly administered, since this method of administration depresses the heart to a considerable degree.

Occasionally in the treatment of malaria Warburg's tincture, containing quinine and numerous aromatics, is efficient.

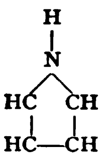
In obstinate malarial affections aromatics and spices greatly enhance the effect of quinine, capsicum making one of the best adjuvants. The portal circulation is stimulated, rendering the absorption of the drug more rapid and its effects more lasting.

The various tinctures and elixirs of cinchona are used extensively; when employed as stomachics they should be given before meals.

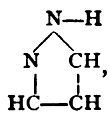
Quinine is best given on an empty stomach or after the active process of digestion is completed.

II. PYRRHOL GROUP.

These bodies are derivatives of pyrrazol. Thus pyrrhol,

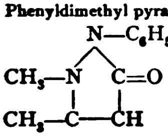


, by the replacing of another N,



, is converted into pyrrazol. In antipyrine, a phenol radical is substituted for the NH of pyrrhol, and two methyl groups and oxygen introduced, thus—

Phenyldimethyl pyrazolon.



Isomeric compounds of antipyrine are known which are inert.

Antipyrīna—Antipyrīnæ—Antipyrine. *U. S. P.*

Definition.—Phenyldimethylpyrazolon obtained by the condensation of phenylhydrazine with aceto-acetic ether and methylation of the product.

Description and Properties.—A white, crystalline powder, odorless, of a slightly bitter taste, freely soluble in water, alcohol, and chloroform.

Dose.—3–20 grains (0.19–13.0 Gm.).

Antagonists and Incompatibles.—Antipyrine is incompatible with spirit of nitrous ether and nitrous compounds, the chlorides of mercury, the iodides of arsenic and mercury, the ferric salts in solution, tincture of iodine, most of the vegetable astringents, phenol, chloral, beta-naphthol, sodium bicarbonate, sodium salicylate, and the salts of quinine and caffeine.

Physiological Action.—On the skin it has no action. It irritates mucous membranes and blanches them, and is an analgesic. Hypodermically administered it often forms abscess. Antipyrine is a weak antiseptic.

Digestive System.—Antipyrine being readily soluble, is absorbed rapidly. It is slightly irritant to the stomach, blanches its surface by local contraction of the blood-vessels, and may act as a hemostatic. It hinders the activity of ferments like pepsin and diastase, and may even cause nausea and vomiting. It has little or no action on the intestines, because of its rapid absorption.

Circulation.—In small doses after a preliminary rise in blood-pressure the vessels dilate and the peripheral blood-pressure falls. The central pressure is not much affected. The pulse rate, at first accelerated, becomes slower. The effects of toxic doses is to cause distinct loss of blood and a weak, feeble heart.

Antipyrine has no appreciable action on the blood itself. In this respect it varies greatly from the aniline derivatives, and from this point of view is a much safer analgesic.

Nervous System.—Antipyrine has a pronounced action on the nervous system. It causes irritability of the motor cortex, in lower animals bringing about convulsive seizures. In man it may bring about excitement and a peculiar type of intoxication, accompanied with marked general analgesia. It occasionally interferes with normal intellectual labor. It excites the medulla and then brings about a diminution in its functions and may abolish the spinal reflexes. The cutaneous nerves of sensation are rendered markedly analgesic.

Temperature.—Antipyrine reduces temperature very rapidly in fever. Its action in health is slight. The heat reduction is largely due to increased surface evaporation, from dilated blood-vessels and increase of perspiration. The exact mechanism is not as yet fully understood. A certain proportion of the heat reduction is due to a retardation of metabolism. This is probably not as marked for antipyrine as it is for the quinolines.

Antipyrine is very apt to cause a rash. This rash may resemble the eruption of many eruptive fevers, and hence the use of antipyrine should be withheld in these conditions until a definite diagnosis is made.

Poisoning.—In large doses, 30 grains and over, in some individuals, even in smaller doses, it may bring about a marked feeling of chilliness, dyspnea, vertigo with rapid and feeble heart action, unconsciousness, and collapse. Occasionally, convulsive seizures are noted. Cyanosis is usually present, irregular breathing, even Cheyne-Stokes rhymth; the pulse is small and death may result from cardiac collapse. The temperature usually falls, but often while the patient is in coma there may be a distinct rise in the temperature. 45 grains (3 Gm.) has caused death in a patient with a weak heart. 7½ grains (5 Gm.) has caused serious symptoms. The continuous use of small doses of antipyrine has been known to bring about a tendency to hemorrhages from the mucous membranes.

In large doses it causes slow and irregular breathing.

Absorption and Elimination.—*Kidneys.*—Antipyrine lessens the amount of urine, urea, and uric acid excreted, but increases the amount of sulphuric acid in the urine.

Therapeutics.—As an analgesic antipyrine probably ranks next to opium, and is useful in all conditions which call for the treatment of pain. The anesthesia produced by antipyrine often lasts for several hours or even days. In acute *coryza* and *inflammation of the pharynx* great relief is obtained by spraying the parts with a 2 or 4 per cent. solution, after applying a solution of cocaine to prevent the primary smarting and irritation which the antipyrine produces.

A 20 per cent. solution has been used in *otitis*, and a 4 per cent. solution has been found very efficient in *cystitis*.

Antipyrine has been used with some success in *diabetes mellitus* and *malarial diseases*, particularly in *intermittent fever*. It does not, however, possess the antiperiodic and specific action of quinine in malarial poisoning. It is an excellent antispasmodic in *whooping-cough*, *laryngitis*, and *asthma*.

Administration.—The drug is best given in water or some aromatic water or syrup. It should not be given hypodermically. In hemorrhage the powdered drug may be applied locally, or a 40 per cent. solution, which causes less irritation. From ½–2 grains (0.03–0.12 Gm.), once or twice a day, is sufficient for children. Ordinarily, a dose of 5 grains (0.3 Gm.) is sufficient for an adult.

Allied Compounds.

Antipyrine unites with resorcin to form **resopyrin**; with salicylic acid to form **salipyrin**; with chloral hydrate to form **hypnal** and other compounds. **Pyramidon** is a dimethylamido substitution product of antipyrine. **Ferripyrin** is a combination of ferric chloride and antipyrine. Many other compounds are known. Antipyrine is a constituent of many "migraine powders."

Dose.—Average dose: 4 grains, (0.250 Gm. = 250 milligrammes), U. S. P.

Caution.—On account of the wide range of incompatibilities already indicated, the greatest caution should be observed in combining antipyrine with other substances.

III. HYDRAZINE DERIVATIVES.

Practically none of the hydrazines is in use at present. *Phenyl-hydrazine*, *pyrodine*, a related compound, *antithermine*, *orthin*, and *agathine*, a salicylic acid substitution product, were at one time in use. They depress temperature very rapidly, but the depression is but temporary only, and as they cause severe poisoning they have been abandoned. The symptoms of poisoning from the hydrazines have been: profuse sweating, with reduction of temperature; cyanosis from the rapid formation of methemoglobin, icterus, a rapid fluttering pulse with great depression, dyspnea and death from respiratory failure.

IV. THE ANILINES.

A large number of very valuable analgesic antipyretics have found a definite place in practical medicine. Their number is liable to increase very materially. In general the pharmacodynamic action of all of the aniline derivatives is similar. They are all poisonous, but their toxic actions will vary, largely, depending on dosage, on the nature of the substituted radicle, on the position in the molecule of the substituted radicle. In all of the anilines the skin, the digestive tract, the nervous system, and the blood are affected. Skin eruptions are various, herpes, urticaria, prurigo, pemphigus, ecthyma, or eczema may be encountered.

The digestive symptoms are numerous and variable. Anorexia is common, constipation is also characteristic; nausea and vomiting not infrequent.

The nervous system may present symptoms of paresis or paralysis of the voluntary muscles particularly, and analgesic action is constant for all of the anilines.

The blood-changes induced by this group are of extreme importance. They may consist of oxygen fixation with the formation of methemoglobin or even of hemolysis, with methemoglobin production. These blood-changes are largely due to the action of para-amido-phenol, into which, or compounds of which, practically all of the derivatives of this series are broken down.

The number of these compounds is so numerous that only those that have been clinically valuable can be mentioned. The chief of the earlier members of this group is acetanilid.

Acetanilīdum[1]—Acetanilīdi—Acetanilid. *U. S. P.*

Origin.—The monacetyl derivation of aniline.

Description and Properties.—White, shining, micaceous, crystalline laminæ, or a crystalline powder, odorless, faintly burning taste, permanent in air, neutral to litmus-paper. It is soluble, at 25° C. (77° F.), in 179 parts of water, 2.5 parts of alcohol, 18 parts of boiling water, and in 0.4 part of boiling alcohol; also in 18 parts of ether, and easily soluble in chloroform.

Dose.—2–10 grains (0.1–0.65 Gm.) [4 grains (0.25 Gm.), U. S. P.].

[1] *Antifebrin* is a copyrighted name for *acetanilid* or *phenylacetamide*, as it is sometimes called. Many proprietary remedies sold at comparatively high prices are mixtures of acetanilid and other compounds.

Official Preparation.

Pŭlvis Acetanilĭdi Compŏsitus—Pŭlveris Acetanilĭdi Compŏsiti—Compound Acetanilid Powder (U. S. P.).—A mixture of acetanilid, caffeine, and sodium bicarbonate; it is a modification of the National Formulary article of the same name and has been known as acetanilid compound (Aulde). The sodium bicarbonate increases the solubility of the acetanilid.

Dose.—Average dose, $7\frac{1}{2}$ grains (0.500 Gm. = 500 milligrammes), U. S. P.

Acetanilid is the cheapest of the common analgesics and it is extensively used in the "headache powders[1]" sold under such a variety of names. These powders frequently contain also caffeine and an alkaline salt, usually sodium bicarbonate or ammonium carbonate.

Physiological Action.—*Externally and Locally.*—Antiseptic, slightly sedative.

Internally.—Digestive System.—Non-irritating, sedative; medicinal doses sometimes allay nausea.

Circulatory System.—In medicinal doses the arterial tension is slightly raised, while the heart is slowed. Toxic doses directly depress the heart and vasomotor mechanism, causing an immediate fall of arterial pressure and great cardiac depression.

In large doses or when taken for some time in comparatively small doses acetanilid develops the characteristic blood-changes spoken of. Methemoglobin is formed, and in very large doses hemolysis may occur.

Nervous System.—In medicinal doses acetanilid is a sedative to the sensory nerves and spinal cord. Small doses are mildly stimulant to the brain, and under certain conditions the drug is a hypnotic. Toxic doses result in general anesthesia and abolition of reflexes, with paralysis of motor and sensory nerves.

Respiratory System.—Medicinal doses produce no special effect. When toxic doses are given there is a rapid and labored respiration. Death is produced by respiratory failure, due to direct action of the drug upon the respiratory center, and indirectly by greatly decreasing the oxygen-carrying power of the blood and by paralyzing the peripheral motor nerves.

Absorption and Elimination.—Acetanilid is an active diuretic, increasing the excretion of urea, and to some extent the excretion of uric acid. After toxic doses have been taken the urine becomes dark or brownish in color, from the presence of disorganized corpuscular elements of the blood. Acetanilid is chiefly eliminated by the kidneys as para-amido-phenol combined with acetic, sulphuric, or glycuronic acids.

Temperature.—Acetanilid has little or no effect on the normal body temperature; but if the latter is above normal, the drug has a marked antipyretic action, often reducing the temperature to below normal. This effect of acetanilid, and of the aniline group in general, is due largely to the action of the drug on the heat-governing mechanism. When the body is in a state of hyperpyrexia the heat-governing mechanism is in an irritable condition, owing

[1] For analysis of a number of these powders, see *Jour. Am. Med. Assoc.*, vol. xliv., p. 1791, 1905.

to certain poisons circulating in the blood, and will not respond to the normal limit (98.6° F.) of body temperature. Acetanilid causes this mechanism to respond to a lower temperature, and, through its action on the vasomotor center, stimulates the vasodilators, thereby augmenting the peripheral circulation with consequent increase of heat-dissipation. The exact mechanism is far from being understood.

Eye.—Medicinal doses have no apparent influence on the eye. Toxic doses have produced contracted and motionless pupils.

Untoward Action.—Under prolonged use of acetanilid congestion of the liver, kidneys, and spleen occurs. Paroxysms of sneezing have apparently been induced by a medicinal dose, and, under the same, redness of the skin, chilliness, and cyanosis have sometimes ensued.

Poisoning.—The skin is cyanosed, the face is livid and anxious, and the body is covered with cold sweat. There may be vomiting; the pulse is soft, slow, later rapid, and weak, accompanied by profound prostration. The respirations are first rapid and labored, and later slow and very shallow, death resulting usually from respiratory paralysis. There may be hallucinations, muscle twitchings, convulsions from asphyxiation, icterus, and skin eruptions. After death the heart, liver, and kidneys are found in a state of acute fatty degeneration. 7½ grains (0.5 Gm.) given nine times in five days has caused death; 30 grains (2 Gm.) within twenty-four hours has also been fatal, and 1 grain (0.5 Gm.) has caused the death of a one-year-old child.

Treatment of Poisoning.—Diffusible stimulants, like alcohol, in small doses, ammonia, and sulphuric ether. Coffee, atropine, and strychnine hypodermically as circulatory and respiratory stimulants. External heat and, if necessary, oxygen inhalations to overcome cyanosis. Artificial respiration is imperative.

Therapeutics.—*Externally and Locally.*—Acetanilid has been locally applied for the treatment of *chancre* and *chancroid*, but there are other antiseptics which are generally considered to be more satisfactory. It is quite an active hemostatic, and may be used in *epistaxis* and *hemoptysis.*

Internally.—The use of acetanilid in fevers has been practically abandoned by the great majority of clinicians. If an antipyretic of this character is indicated at all, it is in *sthenic fevers*, and then to be used only with great care. Its tendency to cause cardiac depression, profuse sweating, and collapse renders its use harmful, if not unsafe, in low conditions like *typhoid fever* and advanced *phthisis.* It may often be administered with good effect in the first stage of *pneumonia.* The headache, fever, and other unpleasant symptoms in the *exanthemata* are greatly modified by its use, although when this drug is given to children they must be very carefully watched to avoid untoward effects.

In *acute tonsillitis*, in *influenza*, in *acute bronchitis*, acetanilid is very serviceable.

There is considerable difference of opinion in regard to the utility of acetanilid in *rheumatism*. Some authorities believe that it exercises a most favorable influence in the acute articular variety, being less apt to disturb the brain than salicylic acid or its salts. The drug certainly mitigates, and often entirely relieves, the pain and swelling, while it reduces the fever. Like salicylic acid, it has no power to prevent heart-complications, but, on the contrary, it should be used with great care, if at all, when such complications exist. It has no tendency to prevent relapses.

The dose of acetanilid in acute rheumatism should not exceed 6 grains (0.5 Gm.) three times a day.

Acetanilid is a very efficient analgesic, and the introduction of this drug, antipyrine, and other remedies of this character has enabled the physician to relieve the pains of certain *spinal diseases* more efficiently than was possible before.

The crises of *locomotor ataxia* are often promptly relieved by acetanilid. *Neuralgias* of every kind indicate its use. The pains of *neuritis*, *lumbago*, *gastralgia*, *dysmenorrhea*, *sciatica*, *tabes dorsalis*, and nearly every kind of *headache* usually yield to its analgesic influence.

In many cases of *chorea* and *epilepsy* (especially the diurnal variety), and in those cases characterized by full habit and high arterial tension, the drug has often been employed to advantage.

Pains which are paroxysmal in character yield best to acetanilid. It quiets the excitement in *mania a potu*, and frequently lessens the paroxysms of *whooping-cough*.

In doses of 3 to 5 grains (0.2–0.032 Gm.), thrice daily, acetanilid has proved efficient as a relief for *seasickness*. It has also been found serviceable in traumatic *tetanus*, purely to quiet the nervous symptoms.

The author has found it to be of great value in *influenza*, or "la grippe," combined or given alternately with salol, aspirin, or sodium salicylate.

Contraindications.—In low fevers, at any rate, not in repeated doses; in fatty or dilated heart, blood disorders, advanced tubercular disease, and exhaustion from hemorrhages.

Administration.—It may be prescribed in powders, pills, compressed tablets, capsules, or alcoholic solution. A speedier effect is produced if it is taken dissolved in a small quantity of alcohol or wine diluted with water.

The average dose as an antipyretic usually should not exceed 5 grains (0.3 Gm.); as an anodyne, 2 to 5 grains (0.1–0.3 Gm.). It may be repeated at intervals of about four hours or less, according to its effects.

Exălgine (Methylacetănilide).

Origin.—As the chemical name indicates, this substance is a derivative of acetanilid.

Description and Properties.—Exalgine occurs in colorless needles or prisms, inodorous and tasteless. It is neutral to test-paper, and is freely soluble in alcohol,

chloroform, carbon disulphide, and boiling water. It requires about 60 parts of cold water or 10 parts of ether for solution.

Dose.—2–4 grains (0.1–0.2 Gm.).

Antagonists and Incompatibles.—Exalgine is incompatible with the iodides, salicylic acid, and solution of potassa.

Synergists.—All members of this group, as well as opium, cocaine, belladonna, and hyoscyamus.

Physiological Action.—Exalgine is almost identical in its action with acetanilid, with the exception that it possesses less antipyretic power. In medicinal doses the drug increases arterial tension, and in full doses profoundly affects the cerebrospinal axis. It is more uncertain and not as safe as acetanilid.

Acetphenetidīnum—Acetphenetidīni—Acetphenetidin. *U. S. P.*

(Phenacetin.)

Description.—The derivation of acetphenetidin is shown by the following formulas:

$$C_6H_4<^{OH}_{H} \longrightarrow C_6H_4<^{OH\ (1)}_{NH_2(4)} \longrightarrow C_6H_4<^{OC_2H_5}_{NH_2} \longrightarrow C_6H_4<^{OC_2H_5}_{NH(COCH_3)}$$

Phenol. Para-amidophenol. Para-phenetidin (Para-amido-phenetol). Acet-paraphenetidin (*phenacetin*).

It may be regarded as acetanilide, $C_6H_4<^{H}_{NH(COCH_3)}$, in which one hydrogen atom is replaced by the ethoxy group (OC_2H_5). It occurs as white, glistening, crystalline scales, or fine crystalline powder, odorless and tasteless. It is slightly soluble in water (1 : 925), much more so in boiling water (1 : 70), and still more so in alcohol (1 : 12). It is frequently adulterated with acetanilide, which may be recognized by the pharmacopœial test.

Incompatibility.—Incompatible with phenol, chloral hydrate, iodine, salicylic acid, and oxidizing agents.

Dose.—Average dose, 7½ grains (0.500 Gm. = 500 milligrammes), U. S. P.

Physiological Action.—Phenacetin differs from acetanilid only in the greater slowness of its action.

It is a distinct diuretic, but not so active as acetanilid. When large doses have been taken the urine is dark-yellow in color and gives the reaction for sugar.

As an antipyretic phenacetin is slower in its action than acetanilid, this slowness of action thus rendering it somewhat safer; nor is it so powerful as an analgesic and hypnotic.

Therapeutics.—Phenacetin is given in the same class of diseases as acetanilid.

Contraindications.—The same as for acetanilid.

Administration.—The drug may be dispensed in powders, pills, capsules, tablets, or suspended in mucilaginous drinks.

Phĕnocoll.

Origin.—Amido-acetparaphenetidin, a glycocoll derivative of phenetidin. The *phenocoll hydrochloride* is the salt used in medicine.

Description and Properties.—A white, crystalline powder, soluble in 16 parts of water, and freely soluble in hot alcohol, forming a neutral solution.

Dose.—3–15 grains (0.2–1.0 Gm.).

Incompatibles.—All the alkalies.

Physiological Action.—Phenocoll differs from phenacetine in no essential particulars.

Other phenetidine bodies are:

Lactophenin, in which a lactyl derivative is added to phenetidine. It is more soluble than phenacetine, and the lactyl group is supposed to add some hypnotic action.

Saliphenin is too weak to be of any service.

Citrophen and *Apolysin* are combinations of citric acid and phenetidin. The citric acid radical was added for its stimulating effect on the heart, and hence these two are reputed to overcome the phenetidin-depressing effect on this viscus. The action, however, clinically, cannot be detected from that of phenacetin, and, moreover, there are certain objections, in the way of the splitting of these compounds in the stomach, which render them less suitable than phenacetine.

Salicylphenetidin was devised to combine the antirheumatic and antipyretic factors, but it appears that this compound is too stable and does not break up into its constituents, and is found in the urine in its original form.

Malakin is somewhat similar to the former drug. It breaks off a phenetidin, however, but is very slow of action and requires large doses to reduce the temperature.

Salocoll is similar to phenocoll plus salicylic acid.

Phesin and *Cosaprin* are new sulphur compounds of phenacetin and acetanilid, respectively, in which the sulphur radical is introduced to reduce the blood-toxic action. They offer no particular advantages.

RESTORATIVES AND ALTERATIVES.

THESE old terms of the Materia Medica are here retained for purposes of convenience. By them is meant that certain substances exert a distinct influence on the metabolism of many of the bodily organs, and that they thus alter the nutritional state of the body, in part or as a whole, and that they have their chief use in therapeutics to so influence certain metabolic activities. Thus, it is known that arsenic affects the nutrition of the skin; it induces in large amounts characteristic nutritional disturbances. Iron has a profound part to play in the blood-composition and on the oxidizing functions of the body. Mercury has a peculiar action on certain pathological states, and exerts a specific activity in overcoming the effects of the syphilitic infection—how, it is as yet undetermined. Salts of iodine show similar properties. Other illustrations are numerous.

It is obvious to every reflecting physician that a class of remedies act as such by supplying some deficiency in the animal organism, the agent in such cases being either itself, the substance lacking, or its analogue, or by its presence restoring the deficient element or secretion. Iron acts in certain forms of anemia in which this ingredient is wanting in the red blood-corpuscles; phosphorus or the earthy salts behave similarly in conditions where the tissues are deficient in these necessary constituents. In view of the physiological action of remedies belonging to this class the term *restoratives* so aptly expresses their general character that no apology is needed for its adoption.

Alteratives, on the other hand, are unnatural to the system and can be administered without injurious results, as a rule, only in *diseased* conditions, in which the particular remedy combats in a specific or unknown way the prime etiological factor of the disease. These medicines when given as *alteratives* normally produce no symptoms, the patient being unaware of their action save by a recognition of his gradually improved condition. Should, in fact, symptoms occur, they should serve as a warning that the remedy is not indicated or that the dose is unsuitable.

Restoratives and alteratives belong for the most part to the general group of the metals and metalloids, and show certain general similarities of action.

RESTORATIVES.

Fĕrrum—Fĕrri—Iron. *U. S. P.*

Definition.—Metallic iron, in the form of fine, bright, and non-elastic wire.

Preparations of Iron.

Fĕrrum Redŭctum—Fĕrri Redŭcti—Reduced Iron (U. S. P.). (IRON BY HYDROGEN; QUEVENNE'S IRON.)—*Origin.*—Obtained by passing hydrogen through a hot, closed tube containing freshly prepared and thoroughly washed ferric oxide. It should contain not less than 90 per cent. of pure metallic iron.

Description and Properties.—A very fine, grayish-black, lustreless powder, odorless and tasteless; permanent in dry air; insoluble in water or alcohol.

Dose.—1–5 grains (0.065–0.3 Gm.) [1 grain (0.065 Gm.), U. S. P.].

Fĕrri Carbōnas Saccharātus—Fĕrri Carbonātis Saccharāti—Saccharated Ferrous Carbonate (U. S. P.).—*Origin.*—Prepared from ferrous sulphate, sodium bicarbonate, sugar, and distilled water, by solution and filtration. It should contain not less than 15 per cent. of ferrous carbonate.

Description and Properties.—A greenish-brown powder gradually becoming oxidized by contact with air; without odor, and having at first a sweetish, afterward a slightly ferruginous, taste. Only partly soluble in water, but completely soluble in hydrochloric acid, with copious evolution of carbonic acid gas, forming a clear, greenish-yellow liquid. The product should be kept in small, well-stoppered bottles.

Dose.—2–10 grains (0.12–0.6 Gm.) [4 grains (0.25 Gm.), U. S. P.].

Măssa Fĕrri Carbonātis—Măssæ Fĕrri Carbonātis—Mass of Ferrous Carbonate (U. S. P.). (VALLET'S MASS.)—*Origin.*—Prepared by solution, filtration, and evaporation from ferrous sulphate, sodium carbonate, clarified honey, sugar, syrup, and distilled water.

Description and Properties.—When recently prepared, the mass is of a greenish-gray color, but on exposure it becomes greenish-black.

Dose.—3–5 grains (0.15–0.3 Gm.) [4 grains (0.25 Gm.), U. S. P.].

Mistūra Fĕrri Compŏsita—Mistūræ Fĕrri Compŏsitæ—Compound Iron Mixture (U. S. P.). (GRIFFITH'S MIXTURE.)—*Origin.*—Prepared by mixing ferrous sulphate, myrrh, sugar, potassium carbonate, spirit of lavender, and rose water.

Description and Properties.—When newly prepared it is of a dirty-greenish color, but slowly oxidizes on exposure to the air, and should therefore be freshly prepared when needed.

Dose.—½–1½ ounces (15.0–45.0 Cc.) [4 drams (16 Cc.), U. S. P.].

Pĭlulæ Fĕrri Iōdidi—Pĭlulas (acc.) **Fĕrri Iōdidi—Pills of Ferrous Iodide** (U. S. P.).—*Origin.*—Pills made of reduced iron, iodine, glycyrrhiza, sugar, extract of glycyrrhiza, acacia, balsam of tolu, water, and ether, evaporated to pilular consistence.

Description and Properties.—These preparations are very unstable, and should be kept from the light as much as possible.

Dose.—One or two pills, each pill containing nearly 1 grain (0.065 Gm.) of ferrous iodide.

Sȳrupus Fĕrri Iōdidi—Sȳrupi Fĕrri Iōdidi—Syrup of Ferrous Iodide (U. S. P.).—*Origin.*—A syrupy liquid containing 5 per cent. by weight of ferrous iodide.

Description and Properties.—A transparent, pale-green liquid, having a sweet, strongly ferruginous taste and a neutral reaction.

Dose.—5–30 minims (0.3–2.0 Cc.) [15 minims (1 Cc.), U. S. P.].

Fĕrri Chlōridum—Fĕrri Chlōridi—Ferric Chloride.—*Origin.*—Prepared by the action of hydrochloric acid and distilled water upon iron wire, subsequent filtration, addition of nitric acid, and crystallization. It should contain not less than 22 per cent. of metallic iron in the form of chloride.

Description and Properties.—Orange-yellow, crystalline pieces, odorless, or having a faint odor of hydrochloric acid and a strongly styptic taste; very deliquescent in moist air; freely and completely soluble in water or alcohol, also in a mixture of 1 part of ether and 3 parts of alcohol. Ferric chloride should be kept in glass-stoppered bottles, protected from light.

Dose.—It is chiefly used topically, as an astringent and hemostatic [1 grain (0.065 Gm.), U. S. P.].

Lĭquor Fĕrri Chlōridi—Liquōris Fĕrri Chlōridi—Solution of Ferric Chloride (U. S. P.).—*Origin.*—An aqueous solution of ferric chloride, $FeCl_3$, containing not less than 29 per cent. of the anhydrous salt, corresponding to 10 per cent. of metallic iron.

Description and Properties.—A reddish-brown liquid, having a faint odor of hydrochloric acid, an acid, strongly styptic taste, and an acid reaction.

Dose.—2–10 minims (0.12–0.6 Cc.), largely diluted [1½ minims (0.1 Cc.), U. S. P.].

Tinctūra Fĕrri Chlōridi—Tinctūræ Fĕrri Chlōridi—Tincture of Ferric Chloride (U. S. P.).—*Origin.*—A hydro-alcoholic solution of ferric chloride, containing about 13.28 per cent. of the anhydrous salt, corresponding to about 4.6 per cent. of metallic iron.

Description and Properties.—A bright, brownish liquid, having a slightly ethereal odor, a very astringent, styptic taste, and an acid reaction.

Dose.—5–30 minims (0.3–2.0 Cc.) [8 minims (0.5 Cc.), U. S. P.].

Līquor Fĕrri et Ammōnii Acetātis—Liquōris Fĕrri et Ammōnii Acetātis—Solution of Iron and Ammonium Acetate (U. S. P.) (BASHAM'S MIXTURE.)—*Formula.*—Prepared with tincture of ferric chloride, 40 parts; diluted acetic acid, 60; solution of ammonium acetate, 500; aromatic elixir, 120; glycerin, 120; water, to 1000.

Dose.—1–4 fluidrams (4.0–15.0 Cc.) [4 fluidrams (16 Cc.), U. S. P.].

Fĕrri Cītras—Fĕrri Citrātis—Ferric Citrate (U. S. P.).—*Origin.*—Prepared by evaporating solution of ferric citrate on a water-bath at a temperature not exceeding 60° C. (140° F.). It should contain ferric citrate corresponding in amount to not less than 16 per cent. of metallic iron.

Description and Properties.—Thin, transparent, garnet-red scales, without odor, and having a slightly ferruginous taste. Slowly but completely soluble in cold water, and readily soluble in hot water, but diminishing in solubility with age. Insoluble in alcohol. Ferric citrate should be kept in well-stoppered bottles, protected from light.

Dose.—5–20 grains (0.3–1.20 Gm.), in solution.

Vīnum Fĕrri—Vīni Fĕrri—Wine of Iron (U. S. P.).—*Composition.*—Iron and ammonium citrate, tincture of sweet-orange peel, syrup, and water.

Dose.—½–1 fluidram (2.0–4.0 Cc.) [2 fluidrams (5 Cc.), U. S. P.].

Fĕrri et Ammōnii Cītras—Fĕrri et Ammōnii Citrātis—Iron and Ammonium Citrate (U. S. P.).—*Origin.*—Prepared by evaporating a solution of ferric citrate and ammonia water.

Description and Properties.—Thin, transparent, garnet-red scales, odorless, and having a saline, mildly ferruginous taste; deliquescent in moist air. Completely soluble in water, but insoluble in alcohol.

Dose.—5–10 grains (0.3–0.6 Gm.) [4 grains (0.25 Gm.), U. S. P.].

Fĕrri et Quinīnæ Cītras—Fĕrri et Quinīnæ Citrātis—Iron and Quinine Citrate (U. S. P.).—*Origin.*—Solution of ferric citrate in distilled water and solution of quinine and citric acid in distilled water are mixed, evaporated on a water-bath to the consistence of syrup, and dried on plates of glass.

Description and Properties.—Thin, transparent scales, of a reddish-brown color, without odor, and having a bitter, mildly ferruginous taste; slowly deliquescent in damp air. Gradually but completely soluble in cold water, more readily soluble in hot water, and but partially soluble in alcohol, its solubility diminishing with age. It should be kept in well-stoppered bottles, protected from light.

Dose.—2–10 grains (0.12–0.6 Gm.) [4 grains (0.25 Gm.), U. S. P.].

Elīxir Fĕrri, Quinīnæ et Strychnīnæ Phosphātum—Elixīris Fĕrri, Quinīnæ et Strychnīnæ Phosphāti—Elixir of Iron, Quinine and Strychnine Phosphates (U. S. P.).—Each fluidram contains 1 grain (0.0647 Gm.) of ferric phosphate, ½ grain (0.0324 Gm.) of quinine, and $\frac{1}{64}$ grain (0.001 Gm.) of strychnine. This is the official representative of a large class of popular preparations on the market.

Fĕrri et Quinīnæ Cītras Solūbilis—Fĕrri et Quinīnæ Citrātis Solūbilis—Soluble Iron and Quinine Citrate (U. S. P.).—*Origin.*—Prepared in the same manner as the above salt, but with the addition of ammonia water.

Description and Properties.—Thin, transparent scales, of a greenish, golden-yellow color, odorless, and having a bitter, mildly ferruginous taste; deliquescent in damp air. Rapidly and completely soluble in cold water, but only partially soluble in alcohol. It should be kept in well-stoppered bottles, protected from light.

Dose.—2–10 grains (0.12–0.6 Gm.) [4 grains (0.25 Gm.), U. S. P.].

Fĕrri et Strychnīnæ Cītras—Fĕrri et Strychnīnæ Citrātis—Iron and Strychnine Citrate (U. S. P.).—*Origin.*—Solution of iron and ammonium citrate in distilled water and solution of strychnine and citric acid in distilled water are mixed, evaporated to the consistence of syrup by means of a water-bath, and dried on plates of glass [0.9–10 per cent. strychnine, 16 per cent. metallic iron equivalent].

Description and Properties.—Thin, transparent scales, varying in color from garnet-red to yellowish-brown, without odor, and having a bitter, slightly ferruginous taste; deliquescent in damp air. Readily and completely soluble in water, but only partly soluble in alcohol. It should be kept in well-stoppered bottles, protected from light.

Dose.—1–3 grains (0.06–0.18 Gm.) [2 grains (0.125 Gm.), U. S. P.].

Vīnum Fĕrri Amārum—Vīni Fĕrri Amāri—Bitter Wine of Iron (U. S. P.).—*Composition.*—Soluble iron and quinine citrate, tincture of sweet-orange peel, syrup, white wine.

Dose.—1–2 fluidrams (4.0–8.0 Cc.) [2 fluidrams (8 Cc.), U. S. P.].

Sȳrupus Fĕrri, Quinīnæ et Strychnīnæ Phosphātum—Sȳrupi Fĕrri, Quinīnæ

et Strychninæ Phosphātum—Syrup of the Phosphates of Iron, Quinine, and Strychnine (U. S. P.).—*Dose.*—1-2 fluidrams (4.0–8.0 Cc.) [1 fluidram (4 Cc.), U. S. P.].

Fērri Hydroxīdum—Fērri Hydroxīdi—Ferric Hydroxide (U. S. P.). (HYDRATED OXIDE OF IRON, FERRI OXIDUM HYDRATUM, U. S. P. 1890.)—*Origin.*—To 38 Cc. of a solution of ammonia water in water is added a 100-Cc. solution of ferric sulphate in water, and the precipitate collected.

Description and Properties.—A brownish-red magma, wholly soluble in hydrochloric acid, without effervescence.

Dose.—4 drams (16 Gm.), or *ad libitum* in case of arsenical poisoning.

Fērri Hydroxīdum cum Magnēsia—Fērri Hydroxīdi cum Magnēsia—Ferric Hydroxide with Magnesia (U. S. P.).—Solution of ferric sulphate, magnesia, and water.

Dose.—Amounts as necessary *ad libitum.*

Fērri et Ammōnii Sŭlphas—Fērri et Ammōnii Sulphātis—Ferric Ammonium Sulphate (U. S. P.) (AMMONIO-FERRIC SULPHATE—AMMONIO-FERRIC ALUM). —*Origin.*—The crystals formed by adding ammonium sulphate to a boiling-hot solution of ferric sulphate.

Description and Properties.—Pale-violet, octahedral crystals, odorless, and having an acid, styptic taste; efflorescent on exposure to the air. Soluble in 3 parts of water and in 0.8 part of boiling water; insoluble in alcohol. The product should be kept in well-stoppered bottles.

Dose.—5–15 grains (0.3–1.0 Gm.) [7½ grains (0.5 Gm.), U. S. P.].

Fērri et Ammōnii Tărtras—Fērri et Ammōnii Tartrātis—Iron and Ammonium Tartrate (U. S. P.) (AMMONIO-FERRIC TARTRATE).—*Description and Properties.*—Thin, transparent scales, varying in color from garnet-red to reddish-brown, without odor, and having a sweetish, slightly ferruginous taste; slightly deliquescent in the air. Very soluble in water; insoluble in alcohol. Iron and ammonium tartrate should be kept in well-stoppered bottles, protected from light.

Dose.—10–30 grains (0.6–2.0 Gm.) [4 grains (0.25 Gm.), U. S. P.].

Fērri et Potăssii Tărtras—Fērri et Potăssii Tartrātis—Iron and Potassium Tartrate (U. S. P.) (POTASSIO-FERRIC TARTRATE).—*Description and Properties.*—Thin, transparent scales, varying in color from garnet-red to reddish-brown, without odor, and having a sweetish, slightly ferruginous taste; slightly deliquescent in the air. Very soluble in water; insoluble in alcohol. It should be kept in well-stoppered bottles, protected from light.

Dose.—5–20 grains (0.3–1.2 Gm.) [4 grains (0.25 Gm.), U. S. P.].

Fērri Phŏsphas Solŭbilis—Fērri Phosphātis Solŭbilis—Soluble Ferric Phosphate (U. S. P.).—*Description and Properties.*—Thin, bright-green, transparent scales, odorless, and having an acidulous, slightly saline taste. The salt is permanent in dry air when excluded from light, becoming dark and discolored when exposed to it. Freely and completely soluble in water, but insoluble in alcohol. It should be kept in dark amber-colored, well-stoppered bottles (12 per cent. metallic iron).

Dose.—5–10 grains (0.3–0.6 Gm.) [4 grains (0.25 Gm.), U. S. P.].

Fērri Pyrophŏsphas Solŭbilis—Fērri Pyrophosphātis Solŭbilis—Soluble Ferric Pyrophosphate (U. S. P.).—*Description and Properties.*—Thin, apple-green, transparent scales, without odor, and having an acidulous, slightly saline taste; permanent in dry air if protected from light, and if exposed to it becoming dark and discolored. Freely and completely soluble in water, but insoluble in alcohol. It should be kept in dark amber-colored, well-stoppered bottles (10 per cent. metallic iron).

Dose.—2–5 grains (0.1–0.3 Gm.) [4 grains (0.25 Gm.), U. S. P.].

Fērri Hypophŏsphis—Fērri Hypophosphītis—Ferric Hypophosphite (U. S. P.).—*Origin.*—The precipitate formed by mixing solutions of sodium hypophosphites and ferric chloride or ferric sulphate.

Description and Properties.—A white or grayish-white powder, odorless and nearly tasteless, permanent in the air. Only slightly soluble in water. It should be kept in well-stoppered bottles.

Dose.—5–10 grains (0.3–0.6 Gm.) [3 grains (0.2 Gm.), U. S. P.].

Fērri Sŭlphas—Fērri Sulphātis—Ferrous Sulphate (U. S. P.).—*Origin.*—Obtained by the action of sulphuric acid and water upon iron wire.

Description and Properties.—Large, pale bluish-green, monoclinic prisms, without odor, and having a saline, styptic taste; efflorescent in dry air; on exposure to moist

air the crystals rapidly absorb oxygen, becoming coated with a brownish-yellow, basic ferric sulphate. Soluble in 1.8 parts of water and in 0.3 part of boiling water; insoluble in alcohol.

Dose.—1–3 grains (0.06–0.18 Gm.) [3 grains (0.18 Gm.), U. S. P.].

Fĕrri Sŭlphas Exsiccātus—Fĕrri Sulphātis Exsiccāti—Dried Ferrous Sulphate (U. S. P.).—*Description and Properties.*—A grayish-white powder, slowly but completely soluble in water.

Dose.—½–2 grains (0.03–0.12 Gm.) [2 grains (0.12 Gm.), U. S. P.].

Fĕrri Sŭlphas Granulātus—Fĕrri Sulphātis Granulāti—Granulated Ferrous Sulphate (U. S. P.).—*Description and Properties.*—A pale bluish-green, crystallized powder, which should conform in every respect to the reactions and tests given under Ferri Sulphas in the U. S. P.

Dose.—½–3 grains (0.03–0.18 Gm.) [3 grains (0.18 Gm.), U. S. P.].

Līquor Fĕrri Subsulphātis—Liquōris Fĕrri Subsulphātis—Solution of Ferric Subsulphate (U. S. P.) (SOLUTION OF BASIC FERRIC SULPHATE—MONSEL'S SOLUTION).—*Origin.*—An aqueous solution of basic ferric sulphate—of varying chemical composition—corresponding to about 13.6 per cent. of metallic iron.

Description and Properties.—A dark, reddish-brown liquid, odorless or nearly so, of an acid, strongly styptic taste, and an acid reaction. Miscible with water and alcohol in all proportions, without decomposition.

Dose.—1–10 minims (0.06–0.6 Cc.) [3 minims (0.2 Cc.), U. S. P.], largely diluted —chiefly used, however, as a local styptic.

Līquor Fĕrri Tersulphātis—Līquoris Fĕrri Tersulphātis—Solution of Ferric Sulphate (U. S. P.).—*Origin.*—An aqueous solution of normal ferric sulphate, containing about 36 per cent. of normal ferric sulphate, and corresponding to not less than 10 per cent. of metallic iron.

Description and Properties.—A dark, reddish-brown liquid, almost odorless, having an acid, strongly styptic taste, and an acid reaction. Miscible with water and alcohol in all proportions, without decomposition.

Dose.—1–10 minims (0.06–0.6 Cc.), given in the same manner and for the same purposes as the preceding preparation.

Pĭlulæ Ăloes et Fĕrri—Pĭlulas (acc.) **Ăloes et Fĕrri—Pills of Aloes and Iron** (U. S. P.).—Described under *Aloes.*

Dose.—5–10 grains (0.3–0.6 Gm.), or two or three pills.

Pĭlulæ Fĕrri Carbonātis—Pĭlulas (acc.) **Fĕrri Carbonātis—Pills of Ferrous Carbonate** (U. S. P.) (FERRUGINOUS PILLS—CHALYBEATE PILLS—BLAUD'S PILLS). —*Dose.*—2–5 pills, each pill containing 1 grain (0.064 Gm.) of ferrous carbonate.

Allied Compounds.

Hæmogallol.—*Origin.*—Prepared by the action of pyrogallol on the coloring-matter of the blood.

Description and Properties.—A reddish-brown, tasteless powder.

Dose.—1–8 grains (0.06–0.5 Gm.).

Hæmol.—*Origin.*—Prepared by the action of zinc dust on the coloring-matter of the blood.

Description and Properties.—A blackish-brown powder having a slight taste.

Dose.—1–8 grains (0.06–0.5 Gm.).

Ferratin.—*Origin.*—A compound of iron first obtained by Professor Schmiedeberg from hog's liver.

Description and Properties.—A fine, reddish-brown powder, containing about 7 per cent. of iron. One variety is insoluble, though the sodium ferratin is freely soluble in water.

Dose.—10–20 grains (0.16–1.2 Gm.).

Hæmalbumin.—A preparation said to contain two albuminoids and salts of the blood.

Description and Properties.—A permanent powder, soluble in water and in alcohol.

Dose.—5–15 grains (0.3–1.0 Gm.).

Hæmoglobin.—Said to be the coloring-principle of the solid elements of the blood.

Dose.—1–3 grains (0.06–0.18 Gm.).

Hæmoferrum.—Claimed to be a natural proteid compound of iron obtained from bullock's blood.

Dose.—1–3 grains (0.06–0.18 Gm.).

Iron Quinine Chloride.—A yellowish-red powder, soluble in water, alcohol, and glycerin.

Dose.—1–3 grains (0.06–0.18 Gm.). Used externally as a hemostatic.

Other newer preparations of iron are **Feralboid**, a peptonized albuminate of iron; **Fercremol**, a compound of hemoglobin and iron, containing 3 per cent. of iron. *Dose*, 3–8 grains (0.2–0.5 Gm.); **Ferralbumose**, prepared from fat-free meat and treated with artificial gastric juice; the filtered solution is freed from albumin, filtered, neutralized, and dried *in vacuo*. A 10 per cent. solution of this albumose is precipitated by 10 per cent. ferric chloride, and the precipitate is then dried and powdered. **Ferripyrine**, a combination with three molecules of antipyrine and one of ferric chloride, and said to possess the properties of both constituents. *Dose*, 8 grains (0.5 Gm.) in anemic conditions associated with headaches and neuralgia.

Ferrosol is a double saccharate of ferrous oxide and sodium chloride. It is not precipitated by the addition of acids, alkalies, or by changes in temperature. It contains 0.77 per cent. of iron. **Ferrostyptin**, an iron preparation containing formaldehyd and readily soluble in water, is used as a hemostyptic antiseptic. It is not caustic and is useful in the mouth and nose. *Dose*, 5–8 grains (0.3–0.5 Gm.). **Ferrum caseinatum**, a preparation containing 5.2 per cent. ferric oxide, and prepared by precipitating a solution of lactate of iron with a solution of calcium caseinate. It is tasteless and odorless, and soluble in water made alkaline by sodium carbonate. *Dose*, 5–15 grains (0.3–1.0 Gm.). **Fersan** is one of the many new preparations of blood. It is held to be the phosphoric acid containing albuminoids of the blood. **Sanguinal**, **Sanguiniform**, and **Carniferrin** are other blood-preparations. Many other preparations of iron are daily being added to the already abundant list.

Antagonists and Incompatibles.—The ferric salts are incompatible with tannic and gallic acids and vegetable astringents, and gelatinize mucilage of acacia. The carbonates are also incompatible with tannic and mineral acids and acidulous salts.

The salts of the vegetable acids and the iodides are incompatible with mineral acids, tannic acid, and with alkalies and their carbonates.

Synergists.—All the restorative medicines are synergistic.

Physiological Action.—Iron is an essential element of the body, there being 1 part of iron to 230 of red globules. In many lower animals iron is diffused throughout the bodily protoplasm; in man it is mostly confined to one tissue, the blood. Through the iron compounds of the body much of the oxidizing functions of the various cells are carried on.

When the body is in a normal, healthy condition, sufficient iron is furnished by the mixed diet to answer all physiological requirements. In many diseased conditions, however, there is a deficiency of iron, and it is necessary to restore this element in one way or another.

Externally and Locally.—Neither the soluble ferric nor ferrous salts exert any action upon the unbroken skin. When applied, however, to mucous membranes or denuded surfaces, they are astringent and hemostatic, the ferric salts being the more powerful, coagulating albuminous fluids. The coagulum of albuminate of iron is usually insoluble, hence acts as a protectant and limits penetration or corrosion. The organic salts possess feeble astringent properties. In the iron salts the acid ion plays the more important rôle in its action on protoplasm.

The acid and astringent preparations of iron act upon the teeth.

The ferric oxides are disinfectant, owing to their property of converting oxygen into ozone.

Internally.—Digestive System.—The teeth and tongue are blackened by the preparations of iron. In the stomach, when not contraindicated and in small doses, its slightly irritant and astringent properties render iron quite a valuble stomachic tonic. Under excessive doses or prolonged administration the acid preparations especially are apt to cause gastric derangement—anorexia, nausea, and serious indigestion. The ferric chloride is particularly valuable in that its ingestion does not, like that of other preparations of iron, diminish the supply of hydrochloric acid in the gastric juice.

All the preparations of iron are probably converted into the chloride in the stomach. When entering the *intestines* they are converted into the ferric oxide, ferrous chloride, the alkaline albuminate, and the insoluble sulphide and tannate. Most of the iron preparations are constipating, the phosphate and pyrophosphate being exceptions. They tend to diminish the bile and the secretions from the gastro-intestinal tract. Constipation with dark stools is a frequent result of iron medication.

Circulatory System.—The action of iron upon the blood is of great importance, since, the metal being a normal constituent of that fluid, its administration has a nutrient as well as a medicinal influence. A primary effect is to supply a deficiency of red corpuscles and bring the hemoglobin up to the normal standard. It also increases the number of leucocytes. Iron enables the red corpuscles to convey more oxygen to the tissues, thus increasing metabolic activity in general. Long-continued dosage has been thought to develop a sense of fulness in the blood-vessels, dryness of, and a tendency to hemorrhage from, mucous membranes.

Nervous System.—The general effect is tonic. In patients inclined to plethora, however, certain untoward symptoms may result from prolonged administration, including a feeling of congestion in the cerebrum.

Respiratory System.—No immediate action is perceptible under normal conditions, but in anemic states, by supplying the nerve-centers, muscles, and lungs with better blood, the respiratory power is increased.

Absorption and Elimination.—Opinions differ regarding the form in which iron is absorbed. Probably much of it is converted into the soluble chloride and absorbed as such in the stomach—while a portion, passing into the intestines, may there be converted into the soluble alkaline albuminate capable of absorption. The larger portion of iron taken into the system, however, is changed into the insoluble sulphide and tannate, and excreted as such, giving to the feces a black color. Such part of the iron as enters the circulation combines with the red corpuscles. The salts of the organic acids are absorbed directly into the blood.

Such careful pharmacologists as Bunge, Schmiedeberg, and Hamburger claimed that inorganic preparations of iron are neither

absorbed nor assimilated, maintaining that the blood and hemoglobin are influenced only by the organic compounds. Yet, notwithstanding these statements, clinical experience has fully demonstrated the value of such preparations as reduced iron, tincture of the chloride, carbonate, etc.; and it is still perhaps a mooted question whether appreciable amounts of them are actually absorbed, or whether, according to Bunge, the inorganic prevent the decomposition of the organic salts of iron in the food by fixing the decomposing agents in the intestines. At all events, the beneficial results in anemia and chlorosis of large doses of the inorganic preparations are too manifest to justify abandonment of these agents because of our ignorance touching their *modus operandi*.

At the present time it is fairly well conceded that Bunge was wrong in his general hypothesis, and the recent work of many pharmacologists has shown that most of the ordinary preparations are capable of absorption in the intestine, and it is also probable that iron takes part in a number of synthetic combinations in the liver, some of which may be ultilized in normal metabolism, while others are cast off in the bile and thus re-enter the intestinal canal.

The amount of urea is increased and micturition rendered more frequent by preparations of this metal.

Elimination takes place chiefly by the feces, to which a blackish color is imparted by the formation of ferrous sulphide. The bile, urine, and even the skin, as well as the mucous and serous membranes, share in the excretory process.

Untoward Action.—The continued use of ferruginous preparations has a tendency to impair the normal digestive powers, occasioning even gastric oppression, nausea, and vomiting. Reduced iron, the phosphate, and the pyrophosphate produce less untoward action than other preparations, and the ferrous are better tolerated than the ferric salts. Not infrequently acne of the face, breast, and back is occasioned, while the prolonged administration of the drug may in rare cases be accompanied by hemorrhages from the mucous membranes and symptoms of plethora and vascular excitement. Large doses of the ferrous sulphate may occasion obstruction of the bowels. In some rare instances irritation of the kidneys may be induced, and again iron is often badly tolerated in gouty conditions.

Poisoning.—The ferric preparations in a concentrated form produce all the symptoms of an irritant poison—gastric pain, vomiting, etc.

Treatment of Poisoning.—The stomach should be emptied by an emetic or carefully cleansed, the treatment being followed by the administration of alkali solutions, tannic acid, and demulcent drinks, the procedure being similar to that employed in poisoning from mineral acids.

Therapeutics.—*Externally and Locally.*—The astringent and styptic properties of chlorides and sulphates of iron have rendered

them serviceable in controlling hemorrhage and as local astringents in relaxed conditions of the *pharynx* and *larynx* and mucous membranes generally. The tincture of the chloride has been highly recommended as a local application to the throat in *diphtheria*, and *chronic* and *indolent ulcers* may often be benefited by a wash containing from 2 to 5 grains (0.12–0.3 Gm.) of the sulphate to 1 ounce (30.0 Cc.) of water. In subacute pharyngitis and in tonsillitis tincture of the chloride with glycerine, simple syrup, and chlorate of potash makes an effective mixture.

It is important to remember that it is bad surgery to use the astringent salts of iron in deep wounds or even in superficial ones. Pressure will usually fulfil all the indications of an astringent.

Iron baths are probably of little service.

Internally.—The most important use of iron is to restore the number of red corpuscles and the amount of hemoglobin. In both the primary and secondary anemias iron is useful. In *chlorosis*, especially, it is of great value; but in order that its effects may be most beneficial, cathartics, such as rhubarb and aloes, which do not irritate the intestines, should accompany its use. In the many types of secondary anemia iron is of paramount value. It is used therefore following *hemorrhage*, *acute infections* as, *erysipelas*, *scarlet fever*, *puerperal fever*, *diphtheria*, *measles*, *influenza*, *typhoid*, *tuberculosis*, *syphilis*, etc.

In many constitutional disturbances associated with malnutrition iron is of service. Thus in the *neuralgias*, particularly if secondary anemia is a concomitant cause, in *menstrual disorders*, in *neurasthenia*, in the anemia of the *opium* or *cocaine habitué;* in the anemias due to chronic toxemia of *Bright's disease* it is invaluable; particularly as Basham's mixture.

Contraindications.—Iron is contraindicated in conditions of stomach irritability, as is seen in febrile disturbances and in chronic disorders of that viscus. As a rule, the drug is not well tolerated in acute inflammatory conditions, malignant disease, and in the hemorrhagic diathesis.

Administration.—If the appetite be poor, iron should be administered in small doses (invariably after meals) or preceded by vegetable bitters. The tincture of the chloride and the stronger preparations should be freely diluted with water. The citrate of iron is a mild preparation well adapted for children and persons of delicate stomach.

Probably the salt richest in iron, yet of all the ferruginous preparations the most agreeable and least irritating, is the iron and potassium tartrate. The soluble ferric pyrophosphate is also a mild and pleasant preparation. The compound iron mixture possesses special advantages in the treatment of chlorosis and chronic diseases of the skin, while the solution of iron and ammonium acetate (Basham's mixture) is the best preparation in albuminuria—particularly that accompanying tubular nephritis—it being agreeable and well tolerated.

The best styptic is the ferric subsulphate or its solution.

Dialyzed iron, being agreeable to the taste, was formerly a popular remedy.

Although it has been shown that Bunge's theory of the inability of the body to utilize inorganic salts of iron is untrue, yet many of the newer proteid combinations serve very acceptably in modern therapeutics, especially in those rare cases in which marked idiosyncrasies to the effects of iron exist. Apart from such, however, there is, we believe, little justification, from an economic point at least, in the use of the numerous patented alcoholic combinations of iron salts.

MANGANESE.

This metal is a normal constituent of the body, existing in appreciable, though minute, quantities in the blood, bile, etc. From the fact of its presence in the blood, and because of the similarity of its chemical affinities to those of iron, many observers have advocated its use as a worthy and efficient substitute for the latter agent.

Its **therapeutic** uses as a restorative, or as an alternative or synergist to iron, are based more upon abstract deductions than upon clinical observation. Still, as its chemical character resembles that of iron—though the metal in its operation is often antagonistic to the latter—its salts are of sufficient therapeutic importance to merit brief mention here.

Măngani Diŏxidum Precipitātum—Măngani Diŏxidi Precipitatæ—Precipitated Manganese Dioxide. *U. S. P.*

Definition.—Chiefly manganese dioxide with small amounts of other oxides of manganese, corresponding to not less than 80 per cent. of manganese dioxide.

Origin.—Manganese sulphate, 50; ammonia water, 250; solution of hydrogen dioxide, 250; water q. s.

Description and Properties.—A heavy, very fine black powder, without odor or taste; permanent in the air; insoluble in water or alcohol.

Dose.—5–40 grains (0.3–2.60 Gm.) [4 grains (0.25 Gm.), U. S. P.].

Măngani Hypophŏsphis—Măngani Hypophŏsphis—Manganese Hypophosphites. *U. S. P.*

Definition.—It should contain not less than 97 per cent. of pure manganese hypophosphite ($Mn(PH_2O_2)_2 + H_2O$).

Dose.—Average dose: 3 grains (0.2 Gm. = 200 milligrammes) (U. S. P.). It is contained in syrupus hypophosphitum compositus.

Măngani Sŭlphas—Măngani Sulphātis—Manganese Sulphate. *U. S. P.*

Origin.—Obtained by heating manganese dioxide with sufficiently strong sulphuric acid, evaporation, and crystallization.

Description and Properties.—Colorless or pale rose-colored, transparent,

tetragonal prisms, odorless, and having a slightly bitter and astringent taste; slightly efflorescent in dry air. Soluble in 0.7 part of water and in 0.53 part of boiling water; insoluble in alcohol. Manganese sulphate should be kept in well-stoppered bottles.

Dose.—2–5 grains (0.1–0.3 Gm.) [4 grains (0.25 Gm.), U. S. P.].

(For *Potassium Permanganate* see section on *Antiseptics.*)

Antagonists and Incompatibles.—The salts of lead, silver, and mercury are incompatible with manganese.

Synergists.—Iron is theoretically synergistic, and the salts of zinc, copper, and silver are similar in their action on the nervous system.

Physiological Action.—*Externally and Locally.*—The two salts above mentioned have no important local action.

Internally.—In large doses these salts, especially the sulphate, irritate the gastro-intestinal tract, while excessive doses may even occasion gastro-enteritis. The sulphate acts as an emeto-cathartic and possesses cholagogue properties.

As is the case with many other drugs of this character, *small* doses may even promote the appetite and improve the digestive function. Manganese dioxide is held by many observers to play some rôle as a tissue oxidizer; serving in this function a purpose similar to that of iron. It has been suggested that manganese has a certain catalytic power in the bodily cells. Large doses, or the continued administration of these preparations, affect the system more like zinc than iron, producing great depression, muscular weakness and waste, diminishing the pulse-beat, weakening the heart, and lowering arterial tension. There is, moreover, a tendency to fatty degeneration of the muscles and liver.

Therapeutics.—The manganese dioxide is highly beneficial in amenorrhea and dysmenorrhea, and has been used in the treatment of *gastralgia*, *pyrosis*, and *simple ulcer of the stomach*. Its action probably resembles that of bismuth, though it is a much less efficient remedy than the latter drug.

It is of interest to note that many practitioners say that they derive no benefit from the use of manganese salts alone in the treatment of amenorrhea.

The sulphate is used occasionally as a cholagogue purgative in *malarial jaundice*, although why it should be preferred to many other and superior cholagogues it is difficult to understand. *Gouty dyspepsia* appears to have been much improved by the use of manganese. The association of iron and manganese makes a valuable combination in the treatment of *chlorosis* and many variations of secondary *anemia*.

Phŏsphorus—Phŏsphori—Phosphorus. *U. S. P.*

Definition.—It should contain not less than 99.5 per cent. of pure phosphorus.

Origin.—It exists, chiefly as phosphates, in many minerals and in all plants and animals. It is prepared by treating calcined bones with sulphuric acid, evaporation, and distillation.

Description and Properties.—A translucent, nearly colorless solid, of a waxy luster, having at ordinary temperatures about the consistence of beeswax. When

kept for some time the surface becomes red and occasionally black. Phosphorus has a distinctive and disagreeable odor and taste (*tasting being allowable only in the form of extreme dilution*). When exposed to the air it emits white fumes, visible in the dark, which have an odor somewhat resembling that of garlic. Upon prolonged exposure to air it takes fire spontaneously.

Phosphorus is insoluble, or nearly so, in water, to which, however, it imparts its characteristic disagreeble odor and taste. It is soluble in 350 parts of absolute alcohol, in 80 parts of absolute ether, and in about 50 parts of any fatty oil. It is very soluble in chloroform or in carbon disulphide, the latter yielding a solution to be handled with the greatest care to prevent accident from combustion. The drug should be carefully kept under water, in strong, well-closed vessels, in a secure and moderately cool place, protected from light.

Dose.—$\frac{1}{100}$–$\frac{1}{30}$ grain (0.0006–0.002 Gm.) [$\frac{1}{121}$ grain (0.0005 Gm.), U. S. P.].

Official Preparation.

Pilulæ Phŏsphori—Pilulas (acc.) **Phŏsphori—Pills of Phosphorus.**—*Dose*, one or two pills. Each pill contains $\frac{1}{100}$ grain (0.0006 Gm.) of phosphorus.

Antagonists and Incompatibles.—The principal chemical antidotes are hydrated magnesia, lime water, powdered charcoal, copper sulphate, and old acid turpentine.

Synergists.—Oily or fatty substances generally aid the action of phosphorus by increasing its absorbability. Cod-liver oil and the restoratives generally aid the action of phosphorus.

Physiological Action.—*Externally and Locally.*—Applied to the skin, phosphorus causes local inflammation, ulceration, and possibly gangrene. The fumes, so common in factories in which phosphorus is used—*i. e.*, in making matches—may produce the most serious results—even maxillary necrosis where dental caries is present, as well as great irritation of the conjunctivæ and the respiratory mucous membrane. The graver systemic symptoms are confined to the conditions induced by toxic doses of the drug.

Internally.—Digestive System.—Taken into the stomach, no special effect is apparent as a result of small doses, save that the drug acts as a functional stimulant. Ferment action is not impaired by non-poisonous doses. Large non-toxic doses cause irritation, with anorexia, increased peristalsis, diarrhea. Fatty degeneration of the cells of the mucosa is readily induced.

Circulatory System.—The primary action is stimulating, the pulse-rate rising and acquiring more force, though not firmness. The facial capillaries are dilated, often congested; the cutaneous circulation becomes more rapid; and diaphoresis is produced. Under toxic doses the action of the heart is strongly depressed.

Nervous System.—Small or moderate doses act as general stimulants to the entire nervous system. Toxic effects include coma, and occasionally vertigo, with delirium, convulsions, insensibility, and collapse.

Respiratory System.—The deleterious action of the fumes of phosphorus is exemplified in their irritating effect upon the broncho-pulmonary mucous membrane. Toxic symptoms are often accompanied by serious disturbances, respiratory failure being

among the immediate causes of death. Small doses of phosphorus have no marked action on the function of respiration.

Liver, Bones, and Metabolism.—Phosphorus acts very markedly upon the cells of the liver. Its chief action, apart from certain corrosion effects, may be said to be exerted on this organ. In small doses it probably induces a specific irritation whereby the normal functions of the liver are enhanced. More bile is produced, and it is more highly pigmented. Possibly the so-called tonic properties of phosphorus are dependent on this, as yet little understood, increase in biliary activity. But phosphorus, even in small doses, soon brings about retrograde changes in the liver cells. With these is associated a certain loss in the oxidative properties of this organ. The production of ammonia, leucin, and tyrosin, which are found in the excreta, and the presence of lactic acid in the blood and tissues, seem to show that this loss is one of the early changes induced in the liver cells by this drug. Further irritation leads to engorgement of the organ, mechanical difficulties in the elimination of the bile formed, and general jaundice. Further fatty degeneration takes place, either as a result of the lessened oxidative capacity of the liver, or as a concomitant, and more serious metabolic disturbances occur, which cannot be entered on here. The general fatty degenerations caused are discussed in the paragraph on Poisoning.

The bones also are the site of a specific effect of phosphorus action. This consists largely in a specific irritation of the bone-forming cells, by which they are increased in number and ossifying cartilage lays down more bone than is normally formed. Over-irritation leads very readily to destruction of bone-formation and to necrosis.

Kidneys.—Phosphorus irritates the kidney epithelium. There is albuminuria; fatty casts and blood may even appear in acute poisoning. The urine is increased in amount under small doses. Diminution of urine and anuria, as well as other changes in the substances found in the urine, are symptoms of intoxication.

Absorption and Elimination.—The *modus operandi* of absorption is a matter of some dispute. Absorption is very slow, and if much phosphorus be ingested it may pass through with the feces. Probably a portion of the drug undergoes oxidation in the stomach, and the phosphoric acid formed, combining with the alkalies, enters the blood as phosphates. A part of the phosphorus is dissolved in the fats and oils present in the stomach, probably entering the circulation as elementary phosphorus.

Temperature.—Owing to capillary expansion, the superficial temperature is at first slightly raised, being subsequently diminished. Evaporation and radiation, arising from profuse diaphoresis, contribute to thermal reduction.

Eye.—In chronic poisoning from phosphorus, hemorrhages and patches of degeneration in the retina are sometimes visible; the ophthalmoscopic picture resembling the retinitis of albuminuria.

Under medicinal doses no special effects upon the eye are reported, although, as has been stated, the vapor of phosphorus is highly irritant to the conjunctivæ.

Uterus.—The action of phosphorus tends to increase the menstrual flow.

Untoward Action.—Small doses produce in some individuals severe gastric disturbance, and in rare cases diarrhea, tenesmus, and jaundice. The fatty degeneration of the retinal capillaries, just mentioned—such as results from chronic intoxication affecting workers in match-factories—is an untoward manifestation to be guarded against by every available means.

Poisoning.—The effects of a fatal dose of phosphorus are not immediate. Indeed, as shown by Kionka, large doses of phosphorus may be ingested without any poisonous symptoms, but if the drug is finely divided poisonous symptoms occur. In some patients a rapid onset, thirty minutes to four hours, has been observed. Nausea, vomiting, heart weakness and coma are rapidly followed by death. This type of poisoning is occasionally observed from the use of certain abortion pills sold usually by the Chinese. In the majority of instances the protracted gastro-enteric form of poisoning occurs.

In these forms the acute symptoms subside, and the hope is raised that the patient will recover, but after a lapse of several hours or even two to three days, the symptoms of the acute stage may recur. There is great weakness, accompanied in a large majority of cases by vomiting. Abdominal pains follow, the symptoms becoming more acute, mucus and bile being present in the dejecta, which for a while retain the odor and luminosity of phosphorus. With the cessation of vomiting pain is abated, although it may extend over the entire abdominal region and even be attended with paroxysms.

The foregoing symptoms are accompanied by pronounced anorexia, thirst and fever, a thickly coated or whitish tongue, burning in the throat, and often signs of collapse. The temperature at first may be high; it subsequently sinks below the normal. After thirty-six hours or more jaundice sets in. The liver is usually swollen, and tender to pressure. The urine is diminished, becoming charged with albumin and urates, and even bloody, containing among other ingredients biliary acids and coloring-matter. In fatal cases urea is almost wholly wanting. The stools may be normal, but the general condition is usually marked by diarrhea or constipation and flatulence. Hemorrhage often occurs, wounds bleeding profusely, and as the severity of the symptoms increases delirium ensues, or coma terminating in convulsions.

Serious nervous manifestations are frequently preceded by restlessness, insomnia, headache, and vertigo. In some delirious conditions wild, erotic states of the mind are the precursors of convulsive or comatose symptoms. Somnolence is not uncommon, with partial spasms and contraction or paresis of the voluntary muscles.

In cases of acute poisoning the duration of the malady varies greatly, death occurring at times within a few days, or, again, being deferred for a few weeks. As a rule, recovery is retarded, the elimination of the drug requiring time. $1\frac{1}{2}$ grains (0.1 Gm.) are given as the lethal dose; $\frac{3}{4}$ grain (0.05 Gm.) has proved fatal, and $\frac{1}{4}$ grain has given severe symptoms.

Postmortem examination shows that the liver, heart, kidneys, muscles, capillaries, and arterioles are implicated in the general effects of the poisoning, and are undergoing fatty degeneration.

The symptoms of *chronic poisoning* are in some respects especially marked, inhalation of phosphorus-fumes frequently resulting in pronounced conditions of necrosis, particularly of the lower maxillary, although it has been maintained that this feature of the poisoning is contingent upon denuded surfaces of bone, disintegration or softening of tissues, caries of the teeth, or communicating wounds. Very rarely the palate and frontal bones are similarly attacked.

Treatment of Poisoning.—Emetics and purgatives are from the first necessary. Copper sulphate is the most efficient emetic as well as the best chemical antidote. Hydrated magnesia, charcoal, and lime water have been suggested, yet their action is tardy, and a more efficient antidote is desirable. Several chemical and physiological agents have been employed to counteract the effects of the drug, among them old acid (oxygenated) oil of turpentine and potassium permanganate in a $\frac{1}{8}$ per cent. solution, opium being used as a stimulant to the heart and the circulatory system. Cathartics, such as castor oil, or other oily menstrua, are to be avoided. Some toxicologists teach the contrary doctrine.

As prophylactic measures for the protection of workmen against phosphor-necrosis, masks covering mouth and nose have been found serviceable, as well as inhalation of the vapor of turpentine, obtained by suspending a small bottle of the fluid at the neck. The teeth should be kept constantly in good condition, since caries favors the tendency to necrosis.

Therapeutics.—Phosphorus is not used externally, but internally it is a tonic, especially of the nervous and osseous systems, stimulating protoplasmic activity. According to Gubler, however, "phosphorus is a rapid stimulant, but it acts by causing waste, and not by increasing power; it impoverishes, and does not enrich; it momentarily galvanizes, as it were, the torpid functions, but is incapable of renewing a dilapidated constitution or even a nervous system exhausted by chronic disease."

Clinical experience has certainly demonstrated its utility as a nutrient tonic to the nervous and osseous tissues. In *neurasthenia* and *chronic nervous exhaustion* it is highly efficacious. Some cases of *neuralgia*, particularly of the fifth nerve and accompanied by great debility, may be relieved by full doses administered every four hours.

It is claimed by some observers that attacks of *angina pectoris* have been completely relieved by phosphorus.

It has proved of great value in caries, delayed resolution of bone, *osteomalacia*, and *rachitis*, and the drug is credited with the cure of *pernicious anemia*, though it is singular, if the drug possesses any real value in this disease, that the fact has been recognized by so few observers. Such able men as Fox and Broadbent praise its efficacy in *lymphadenoma*. It possesses some value in the *insomnia of the aged* and the *wakefulness of cerebral anemia*. Phosphorus is also a valuable remedy in *functional impotence*.

Administration.—Since many persons have a peculiar susceptibility to phosphorus, its administration should begin with small doses, and, should it be thought necessary to prolong the administration for an indefinite period, the tendency of the drug to produce general steatosis should not be forgotten.

The phosphorus pill is undoubtedly the best form in which to administer the drug, though it possesses the disadvantages of being insoluble in the intestinal fluids and of producing more or less irritation of the gastro-intestinal mucous membrane. This latter effect is usually unnoticed under ordinary medicinal dosage on a full stomach. The liquid preparations of phosphorus are more unstable, rapidly tending to become inert by oxidation.

Official Derivatives.

Călcii Hypophŏsphis—Călcii Hypophosphītis—Calcium Hypophosphite (U. S. P.).—*Origin.*—Obtained by heating phosphorus with milk of lime and exposing the mixture to the air.

Description and Properties.—Colorless, transparent, monoclinic prisms, or small, lustrous scales, or a white, crystalline powder; odorless, having a nauseous, bitter taste, and permanent in the air. Soluble in 6.5 parts of water and in 6 parts of boiling water; insoluble in alcohol. It should contain not less than 98 per cent. of pure calcium hypophosphite.

Dose, 5–6 grains (0.3–0.4 Gm.) [7½ grains (0.5 Gm.), U. S. P.].

Călcii Phŏsphas Præcipitātus—Călcii Phosphātis Præcipitāti—Precipitated Calcium Phosphate (U. S. P.).—*Origin.*—Prepared by the action of hydrochloric acid and water upon bone-ash, the addition of solution of ammonia to render the mixture of an alkaline reaction, and washing and drying the precipitate. It should contain not less than 99 per cent. of pure calcium phosphate.

Description and Properties.—A light, white, amorphous powder, odorless and tasteless, permanent in the air. Almost insoluble in cold water; partly decomposed by boiling water, which dissolves out an acid salt; almost insoluble in acetic acid, except when freshly precipitated; easily soluble in hydrochloric or nitric acid; insoluble in alcohol.

Dose, 10–30 grains (0.6–2.0 Gm.) [15 grains (1 Gm.), U. S. P.].

Sōdii Hypophŏsphis—Sōdii Hypophosphītis—Sodium Hypophosphite (U. S. P.).—*Origin.*—Prepared by adding sodium carbonate to a solution of calcium hypophosphite and evaporating the filtrate. It should contain not less than 98 per cent. of pure sodium hypophosphite.

Description and Properties.—Small, colorless, transparent, rectangular plates of a pearly lustre, or a white, granular powder, odorless, and having a bitterish-sweet, saline taste. Very deliquescent on exposure to moist air. Soluble in 1 part of water and in 30 parts of alcohol, also in 0.12 part of boiling water and in 1 part of boiling alcohol; slightly soluble in absolute alcohol; insoluble in ether. Sodium hypophosphite should be kept in well-stoppered bottles.

Dose, 5–10 grains (0.3–0.6 Gm.) [15 grains (1 Gm.), U. S. P.].

Potăssii Hypophŏsphis—Potăssii Hypophosphītis—Potassium Hypophosphite (U. S. P.).—*Origin.*—Prepared in a similar manner to calcium hypophosphite, or by double decomposition of calcium hypophosphite and potassium carbonate. It should contain not less than 90 per cent. of pure potassium hypophosphite.

Description and Properties.—White, opaque, hexagonal plates, or crystalline masses, or a granular powder, odorless, and having a pungent, saline taste; very deliquescent. Soluble in 0.6 part of water and in 7.3 parts of alcohol. Potassium hypophosphite should be kept in well-stoppered bottles.

Dose, 5–30 grains (0.3–2.0 Gm.) [7½ grains (0.5 Gm.), U. S. P.].

Ăcidum Hypophosphorōsum—Ăcidi Hypophosphorōsi—Hypophosphorous Acid (U. S. P.).—*Definition.*—A liquid, HPH_2O_2, composed of 30 per cent. by weight of absolute hypophosphorous acid and 30 per cent. of water.

Description.—A colorless, odorless liquid having an acid taste. Miscible in all proportions with water. It is a powerful reducing agent, precipitating metallic silver from solutions of silver nitrate, calomel from corrosive sublimate, etc.; when heated with copper sulphate a yellow precipitate of copper hydride is formed (difference from phosphorous acid). It is used in the preparation of acidum hypophosphorosum dilutum.

Incompatibles.—Incompatible with arsenical salts, and in general with substances that are more or less easily reduced.

Ăcidum Hypophosphorōsum Dilūtum—Ăcidi Hypophosphorōsi Dilūti—Diluted Hypophosphorous Acid (U. S. P.).—*Definition.*—A liquid composed of 10 per cent. by weight of absolute hypophosphorous acid and 90 per cent. of water.

Description and Properties.—A colorless liquid, without odor, and having an acid taste. Specific gravity about 1.042. Miscible in all proportions with water.

Dose.—It is rarely used as a therapeutic agent by itself, but in the syrup of the hypophosphites [8 minims (5 Cc.), U. S. P.].

Sȳrupus Hypophosphītum—Sȳrupi Hypophosphītum—Syrup of Hypophosphites.—*Formula.*—Calcium hypophosphite, 45; sodium hypophosphite, 15; potassium hypophosphite, 15; diluted hypophosphorous acid, 2; tincture of fresh lemon peel, 5; sugar, 650; sufficient water to make 1000.

Dose.—1–2 fluidrams (4.0–8.0 Cc.) [2 fluidrams (8 Cc.), U. S. P.].

Sȳrupus Hypophosphītum Compŏsitus—Sȳrupi Hypophosphītum Compŏsiti—Compound Syrup of Hypophosphites (U. S. P.).—Syrupus hypophosphitum cum Ferro (U. S. P., 1890) is dropped, but this may take its place, as it contains iron, as ferric hypophosphite 0.25 per cent. It contains 5, calcium, potassium, sodium, iron and manganese, hypophosphites, hypophosphorous acid, quinine, and strychnine. It is adopted from the National Formulary and is similar to a number of well-known proprietary preparations.

Dose.—Average dose: 2 fluidrams (8 Cc.), U. S. P.

Elīxir Fĕrri, Quinīnæ et Strychnīnæ Phosphātum—Elixīris Fĕrri, Quinīnæ et Strychnīnæ Phosphāti—Elixir of Iron, Quinine and Strychnine Phosphates. (U. S. P.).—Each fluidram contains 1 grain (0.0647 Gm.) of ferric phosphate, ½ grain (0.0324 Gm.) of quinine, and $\frac{1}{64}$ grain (0.001 Gm.) of strychnine. This is the official representative of a large class of popular preparations on the market.

Dose.—Average dose: 1 fluidram (4 Cc.), U. S. P.

Glycerītum Fĕrri, Quinīnæ et Strychnīnæ Phosphātum—Glycerīti Fĕrri, Ammōniæ et Strychnīnæ Phosphāti—Glycerite of the Phosphates of Iron, Quinine, and Strychnine (U. S. P.).—This preparation is a concentrated form of one of the popular and useful combinations of tonics which might well replace some of the many proprietary preparations; it is prepared according to a fixed and definite formula (see U. S. P.), whereas the latter class are made according to the special formulæ of the different manufacturers. (See also Elixir Ferri, Quininæ et Strychninæ Phosphatum). This glycerite is a stable solution which may be kept in stock, and from which the syrup of the phosphates of iron, quinine, and strychnine may readily be prepared.

Dose.—Average dose: 15 minims (1 Cc.), U. S. P. 1 Cc. contains 1¼ grains (0.080 Gm. = 80 milligrammes) of soluble ferric phosphate, 1⅗ grains (0.104 Gm. = 104 milligrammes) of quinine, and $\frac{1}{80}$ grain (0.0008 Gm. = 0.8 milligrammes) of strychnine. The ratio of quinine to strychnine is four times as great in the glycerite as in the elixir.

Antagonists and Incompatibles.—The sodium and potassium hypophosphites are incompatible with the soluble salts of mercury and silver, and the soluble phosphates and carbonates are incompatible with calcium hypophosphite.

Synergists.—Phosphorus, cod-liver oil, and the restoratives generally.

Physiological Action.—Although not possessing the active and poisonous properties of phosphorus, the HYPOPHOSPHITES are useful as tonic stimulants, being particularly valuable in general furunculosis.

The CALCIUM PHOSPHATE adds the action of calcium to that of the hypophosphite.

The ZINC PHOSPHIDE is more active. In this preparation the zinc ion plays an important part.

Therapeutics.—*Externally and Locally.*—The CALCIUM PHOSPHATE, combined with a little free phosphoric acid, has been recommended by Doubenski in the treatment of *tuberculous ulcerations.* "*Cold abscesses* and *fistulous tracts* were treated by packing with gauze soaked with a solution of 5 parts to 100."

Internally.—The HYPOPHOSPHITES are useful as general tonics. Phosphoric acid has little action as determined by animal experimentation, but negative evidence from such research has no bearing, in view of much positive evidence derived from clinical use. In *chlorosis, anemia, scrofula,* and *tuberculosis* they have been highly recommended. In the opinion of many the benefit derived from their use in the cachexiæ mentioned is slight compared with that of cod-liver oil and the hygienic influences rendered serviceable in these conditions.

Administration.—The zinc phosphide is best given in pill form. The hypophosphites and calcium phosphate may be given in capsules, though the syrup of the hypophosphites is usually preferred. In patients who cannot take sugar, even in small quantities, the syrup may be contraindicated.

ARSENIC.

Ărseni Trioxīdum—Ărseni Trioxīdi—Arsenic Trioxide. *U. S. P.*

(ACIDUM ARSENOSUM. U. S. P., 1890.)

Origin.—Arsenic has been found in minute proportions in many mineral waters. It is obtained in large quantities by roasting arsenical ores—cobalt, nickel, tin, and particularly arsenical iron pyrites—and purifying by resublimation. It should contain not less than 99.8 per cent. of pure arsenic trioxide.

Description and Properties.—It is a heavy solid, occurring either as an opaque white powder or in irregular masses, of two varieties—the one, amorphous, transparent, and colorless, like glass; the other, crystalline, opaque, or white, resembling porcelain. Frequently the glassy variety is found enclosed in an opaque, white crust. Contact with moist air changes the glassy into the white, opaque variety. Both are odorless and tasteless.

Both varieties dissolve very slowly in cold water, the glassy variety requiring about 30, the porcelain-like about 100, parts of water at 25° C. (77° F.). Both are slowly but completely soluble in 15 parts of boiling water. Arsenous acid is but slightly soluble in alcohol, but is soluble in about 5 parts of glycerin. Oil of turpentine dissolves the glassy variety only. Both varieties are freely soluble in hydrochloric acid and in solutions of alkali hydrates and carbonates.

Dose.—$\frac{1}{60}$–$\frac{1}{20}$ grain (0.001–0.003 Gm.) [$\frac{1}{30}$ grain (0.002 Gm.), U. S. P.].

Official Preparations.

Lĭquor Ăcidi Arsenōsi—Liquōris Ăcidi Arsenōsi—Solution of Arsenous Acid.—Strength, 1 per cent. of arsenic trioxide.

Description and Properties.—A clear, colorless liquid, odorless, having an acidulous taste and an acid reaction.

Dose.—2–10 minims (0.12–0.6 Cc.) [3 minims (0.2 Cc.), U. S. P.].

Lĭquor Potăssii Arsenītis—Liquōris Potăssii Arsenītis—Solution of Potassium Arsenite (FOWLER'S SOLUTION).—Strength, 1 per cent. of arsenic trioxide.

Dose.—2–10 minims (0.12–0.6 Cc.) [3 minims (0.2 Cc.), U. S. P.].

Ărseni Iōdidum—Ărseni Iōdidi—Arsenic Iodide. *U. S. P.*

Origin.—Prepared by triturating in a mortar finely powdered metallic arsenic and iodine until they are thoroughly mixed; or by mixing solutions of arsenous and hydriodic acids, and evaporating. It should contain not less than 82.7 per cent. of iodine and 16.3 per cent. of metallic arsenic.

Description and Properties.—Glossy, orange-red, crystalline masses, or shining, orange-red, crystalline scales, having an iodine-like odor and taste; gradually losing iodine on exposure to air and light. Soluble in 12 parts of water and in about 28 parts of alcohol. Arsenic iodide should be kept in glass-stoppered vials, in a cool place, protected from light.

Dose.—$\frac{1}{32}$–$\frac{1}{8}$ grain (0.002–0.008 Gm.) [$\frac{1}{16}$ grain (0.005 Gm.), U. S. P.].

Official Preparation.

Lĭquor Ărseni et Hydrărgyri Iōdidi—Liquōris Ărseni et Hydrărgyri Iōdidi—Solution of Arsenic and Mercuric Iodide—(DONOVAN'S SOLUTION).—Strength: 1 per cent., each, arsenic iodide and mercuric iodide.

Description and Properties.—A clear, pale-yellowish liquid, without odor, and having a disagreeable metallic taste.

Dose.—1–10 minims (0.06–0.6 Cc.) [4½ minims (1 Cc.) U. S. P.].

Sōdii Ărsenas—Sōdii Arsenātis—Sodium Arsenate. *U. S. P.*

Origin.—Prepared by heating to redness arsenous acid, sodium nitrate, and sodium carbonate. Dissolve the fused mass in water and crystallize. Dissolve crystals in water and recrystallize. It should contain not less than 98 per cent. of pure di-sodium-orthoarsenate.

Description and Properties.—Colorless, transparent, monoclinic prisms, odorless, and having a mild, alkaline taste (the salt is very poisonous). Efflorescent in dry air, and somewhat deliquescent in moist air. Soluble in 1.2 parts of water, very soluble in boiling water, and slightly soluble in cold water. Soluble in 60 parts of boiling alcohol. Sodium arsenate should be kept in well-stoppered bottles.

Dose.—$\frac{1}{60}$–$\frac{1}{10}$ grain (0.001–0.006 Gm.) [$\frac{1}{10}$ grain (0.005 Gm.), U. S. P.].

Sōdii Ărsenas Exsiccātus—Sōdii Arsenātis Exsiccāti—Exsiccated Sodium Arsenate. *U. S. P.*

(Also known as ANHYDROUS SODIUM ARSENATE.)

Description and Properties.—An amorphous, odorless, white powder, Na_2HAsO_4. Permanent in dry air. Soluble in 3 parts of water; very soluble in boiling water.

This is prepared from sodium arsenate by expelling by heat the seven molecules of water of the latter. The hydrous sodium arsenate (sodii arsenas, U. S. P.) is efflorescent in dry air and somewhat deliquescent in moist air; hence the percentage of arsenic is somewhat uncertain. The new preparation is permanent in dry air. The hydrous sodium arsenate contains 40.4 per cent. of water; hence, a given weight of this substance

will contain but little more than half as much arsenic as an equal weight of the exsiccated. The average dose of the latter is accordingly placed at about one-half that of the former.

Dose.—Average dose : $\frac{1}{20}$ grain (0.003 Gm. = 3 milligrammes), U. S. P.

Official Preparation.

Līquor Sōdii Arsenātis—Liquōris Sōdii Arsenātis—Solution of Sodium Arsenate (PEARSON'S SOLUTION).—Strength, 1 per cent. of sodium arsenate.

Dose.—1–10 minims (0.06–0.6 Cc.) [3 minims (0.2 Cc.), U. S. P.].

Antagonists and Incompatibles.—Arsenic is incompatible with the salts of iron, silver, magnesia, lime, copper, ammonium, and with vegetable astringents.

Synergists.—Iron and general tonics are synergistic to arsenic.

Physiological Action.—*Externally and Locally.*—Arsenic itself is largely inert. It is partially oxidized, however, particularly in the intestinal canal, and the arsenous acid ion H_3AsO_3 and the anhydride, As_2O_3, are converted into arsenites and are active. Applied to the skin, arsenic acts as a caustic, exciting violent inflammation. Its escharotic influence results in destruction of vitality in the affected parts, accompanied with sloughing. Arsenic may be absorbed from the unbroken skin. Skin eruptions are frequent under arsenical applications.

Internally.—*Digestive System.*—Except in exceedingly small doses arsenic acts as a gastro-intestinal irritant. Minute and medicinal doses stimulate the flow of gastric and intestinal juices, and augment peristalsis, improving the digestive and nutritive functions. When too long continued, the drug produces nausea, diarrhea, and increased micturition, with a sensation of heat and dryness of the throat and stomach. Toxic doses are followed by violent gastroenteritis. Indeed, in whatever manner introduced into the system, arsenic has a marked action upon the gastro-intestinal tract, causing vascular changes, in the nature of dilatation of the capillaries, which when prolonged bring about destructive lesions. (See Chronic Poisoning.)

Circulatory System.—Cardiac action may be slightly stimulated by small doses, the experience of arsenic eaters proving that the drug, so far from being necessarily deleterious, actually tends to invigorate the heart action for a time at least. Large doses render the heart irritable and feeble.

On the blood-making organs, arsenic has a distinct action, though as yet not definitely understood. New-formed blood-cells have been found, and the spleen and long bones seem to be stimulated to increased blood-making activity. Arsenic in its relations to chronic poisoning shows itself to have a destructive action on the minute blood-vessels. It seems, in common with many other substances, to increase the clotting properties of the blood-serum. Capillary thrombi are constant features of chronic toxemia.

Nervous System.—The general effect of arsenic upon the brain and nervous system is that of a tonic. The cerebral functions are somewhat stimulated.

The grade of stimulation caused by arsenic is difficult to determine, as other factors, notably its action on the skin and blood, should be borne in mind. In chronic poisoning (*q. v.*), even from very minute doses, the nervous system is markedly affected, particularly the peripheral nerves, both motor and sensory.

Under prolonged use arsenic tends to accumulate to a greater extent in nervous than in other tissues. Thus, according to Scolosuboff, if 1 part is found in fresh muscle, the proportion in the liver is 10.8; in the brain, 36.5; in the spinal cord, 37.3.

Respiratory System.—Ordinary amounts effect no special change in respiration other than increased power and stimulation of the respiratory center. It has been held, with authority, that small doses stimulate the peripheral endings of the pulmonary vagi. In toxic doses arsenic acts as a powerful respiratory depressant.

Absorption and Elimination.—Arsenic is readily absorbed by the blood. Its presence has also been detected in the viscera, bile, urine, sweat, the bronchial and intestinal mucous membranes, and even in the parenchymatous tissues. It is eliminated slowly from the body by the intestines, and rapidly by the urine; possibly, also, by the bile and the skin. The saliva, milk, and even the tears are said to share in the process of elimination.

Medicinal doses prevent tissue-change, while large doses increase nitrogenous metamorphosis. The therapeutic action is certainly to modify and improve nutrition. Binz has suggested the novel idea that the main activity of arsenic is due to its peculiar oxidizing properties by which arsenous acid is oxidized to arsenic acid, which in turn is reduced to arsenous acid, etc. Thus the alternating oxidation and reduction would account for its stimulating general metabolic activity.

Temperature.—The temperature is unaffected by medicinal doses. Chronic intoxication may be accompanied by a rise in temperature.

Eye.—Large doses, or small doses repeated, are followed by injection of the conjunctivæ, eczema, inflammation, and edema of the lids. This is a manifestation of the general engorgement of the capillaries of the gastro-intestinal and respiratory tract mucosa.

Untoward Action.—Differing from the characteristic symptoms of poisoning occasionally produced by medicinal doses in very susceptible persons, there are induced, not infrequently, restlessness, headache, alopecia areata, bronchitis, hoarseness, disturbances of digestion, thirst, coryza, and, in rare cases, epistaxis, anaphrodisia, icterus, lacrimation, photophobia, amblyopia, dermatitis, and various cutaneous eruptions, frequently followed by desquamation.

An eruption resembling that of measles, produced by 3 drops (0.18 Cc.) of Fowler's solution, is reported by Macnal (*Medical Times and Gazette*, 1868). Falck reports a case in which arsenic produced a discolored sanguinolent eruption with erysipelatous swelling. Papules and erythematous pustules have also been observed.

"Eruptions petechial or ecchymotic, eruptions papular, vesicular,

erysipelatous, pustular—such are the principal forms of arsenical exanthemata," described by Imbert-Gourbeyre.

Poisoning.—Large doses of arsenic taken in the form of rat poisons, fly papers, dyes, and parasiticides (Scheele's and Paris green) produce symptoms of *acute* poisoning, the drug almost immediately manifesting its characteristic effects upon the gastro-intestinal canal (to which it is a marked irritant), exciting active inflammation. There are, in from fifteen minutes to one-half hour, colicky pains in the stomach, nausea, vomiting, looseness of the bowels, and edema of the face, indicated by puffiness under the eyelids. The passages are at length similar to the "rice-water" discharges of cholera, although different from the latter in the presence of blood or serum. The purging becomes obstinate and exhausting. In certain cases other choleraic symptoms are especially manifested, as increasing coldness of the body, and cramps.

There is great prostration, pinched, bloodless face, fall in blood-pressure, the urine is scanty or suppressed, headache, collapse. Death may supervene in from one to four hours with small pulse and sighing respiration. Sometimes the patient recovers from the acute attack, and subsequently dies in from two to three days from the secondary degeneration, as in phosphorus-poisoning. As a minimum lethal dose, 1 grain (0.06 Gm.) of arsenous acid may be mentioned as having caused death, though much larger doses have been recovered from.

Chronic Poisoning.—This may arise from a great variety of sources. In some localities by some peoples, as in Styria, large doses are tolerated for considerable periods of time, apparently with not markedly pernicious effects. Undoubtedly, much of the fame of the arsenic eaters' good health is fictitious, but the clinical evidence goes to show that a tolerance for arsenic may be established.

In chronic poisoning, which may arise from the absorption of very minute amounts of arsenic from earths, food, fruit sprays, paints, wall-paper, carpets (dyed with arsenic dyes), beer (arsenic from glucose, from sulphuric acid), the symptoms may be in (1) Intestinal tract—anorexia, nausea, sometimes vomiting, occasional diarrhea, pain; (2) Mucous membranes of eye, nose, throat, as coryza, sneezing, conjunctivitis, puffiness of eyelids; (3) Skin—as eruptions, pigmentation, herpes, increased growth of hair and nails; (4) Nervous System, as paresthesiæ, followed by peripheral neuritis of arms or legs, or both, neuralgic pains usually accompanying. In terminal stages, mental symptoms, as dementia, with convulsive seizures, etc., may develop.

Treatment of Poisoning.—In the acute poisoning it is necessary that treatment be expeditious, and the agents and methods adopted carefully chosen. Vomiting often renders the use of the stomach-pump unnecessary, yet emetics are frequently serviceable, the cleansing of the stomach being of primary importance. Various antidotes have been successfully used, the best, chemically, being

freshly prepared hydrated sesquioxide of iron, administered in water, 2 or 3 tablespoonfuls every fifteen or twenty minutes. Magnesia, chalk, and lime-water also serve as efficient antidotes. The temperature of the patient should be maintained, and demulcents (oil, milk, etc.) freely given. The after-treatment should include mucilaginous drinks, opiates if indicated, cathartics, and, in case of necessity, stimulants. Active vessel tonics, as ergot, adrenalin, etc., may be useful to overcome the collapse.

In the chronic poisoning, withdrawal of the arsenic and general symptomatic treatment is indicated.

Therapeutics.—*Externally and Locally.*—The chief use of arsenic locally is as an escharotic. For this purpose it is employed to destroy malignant growths, such as *cancer*, *sarcoma of the skin*, and *multiple sarcomatous degeneration* of the lymphatic glands. In the latter affection the parenchymatous injection of 5 minims (0.3 Cc.) of Fowler's solution, diluted with twice the amount of distilled water, is used.

Many of the pastes and "quack" cancer remedies owe most of their efficiency to arsenic. Manec's paste contains arsenous acid, 15 grains (1.0 Gm.); black sulphide of mercury, 75 grains (5.0 Gm.); burnt sponge, 35 grains (2.3 Gm.).

The noted *poudre caustique de Frère Côsme ou du Rousselot* is a similar preparation, containing about the same quantity of arsenic.

The solution of arsenous acid is an excellent local application to *warts* and *corns*. If these growths are very firm and horny, their removal may be facilitated by the previous application of solution of potassa. When used over large surfaces arsenic should be applied in good strength and heroically, so that active inflammation may be excited and the danger of absorption lessened.

Internally.—Arsenic is a peculiarly efficient remedy in *chronic scaly skin diseases.*

Like all other alteratives, it influences diseases of a chronic nature more favorably than acute disorders, invariably aggravating acute skin diseases. This drug, therefore, is one of the most valued remedies in *psoriasis*, *lepra*, and *chronic squamous eczema.*

Pemphigus, *prurigo*, *acne*, and *lichen ruber* have often been favorably influenced by the continued administration of Fowler's solution. In the successful management of these chronic skin diseases it is necessary that the preparation of arsenic employed be given in as large doses as can be tolerated by the patient, and the treatment continued unremittingly for a long period.

Lymphoma, whether superficial or occupying the great cavities, is frequently benefited greatly by similar treatment.

Asthma and *bronchitis*, whether acute or chronic, accompanying or succeeding scaly skin diseases, are singularly amenable to this medicine when the dose is carried to the full physiological limit. Another condition, *dysmenorrhea*, frequently noticed in women with a tendency to asthma or subject to chronic diseases of the skin, is often cured or greatly benefited by arsenic.

The obstinate and often incurable disease known as *pernicious anemia* yields better to arsenic than to any other known remedy.

The statements in the preceding paragraph apply also to *leukemia*, whether *splenic*, *myelogenic*, or *lymphatic*, and to *Hodgkin's disease*.

Arsenic is valuable in the treatment of *malaria*, particularly in the chronic cachectic types. The modus operandi is not yet known. It may be a protozoa poison, or it may increase certain protective properties of the blood-sera. It may have an action on the spleen.

The *neuralgias*, *anemia*, and *headache* of malarial origin are singularly amenable to this medicine.

Fowler first reported the remarkable efficacy of arsenic in *neuralgia of the intercostal* and *fifth pair of nerves*. It is equally valuable in these cases whether the disease be due to malaria or to general debility.

If this drug is specific in any one disease, it is so in *chorea*, very rarely failing to effect a cure when judiciously administered. It should be given in full doses, and increased as tolerance is established.

This medicine seems to act equally well in *gastralgia*. It is also an efficient remedy in *gastritis* or the vomiting of gastritis, especially in that occasioned by the excessive use of alcohol. Many *irritative conditions of the stomach* are relieved by minute doses of Fowler's solution. Excessive peristalsis, resulting in *diarrhea*, coming on immediately after taking food, is usually cured completely by very small doses of Fowler's solution, alone or combined with an equal quantity of tincture of opium. Arsenic has also been recommended in *gastric ulcer* and *cancer*.

It has proved of great service in *hay fever*, *spasmodic asthma*, and *acute coryza*. It is often very serviceable in *catarrhal pneumonia* and in *chronic bronchitis*. Arsenic is useful in *diabetes mellitus*. *Rheumatoid arthritis* is more favorably influenced by the use of arsenic than by any other medicine. It should be employed in the treatment of *chronic rheumatism*. Even in *secondary syphilis* a combination of mercury and arsenic has produced better results, in some cases, than mercury alone. Anstie has recommended arsenic in *angina pectoris*, alleging that it mitigates the severity of the attacks. *Chronic diarrhea*, when induced by intestinal fermentation or chronic malarial infection, is sometimes greatly benefited by this drug.

Finally, arsenic is a valuable adjunct to iron in the treatment of *simple anemia* and *chlorosis*.

Contraindications.—In acute skin diseases and pulmonary tuberculosis with a tendency to hemoptysis.

Administration.—Arsenic should be given ordinarily after meals. There are certain conditions, however, requiring its administration in small doses before meals. When it is desired to give arsenic in pill form, the trioxide should be used; and for solutions the liquor potassii arsenitis is usually preferred.

In syphilitic disorders Donovan's solution is an excellent preparation to use.

Children are much less susceptible to the drug than adults, often being able to take adult doses with impunity.

During a course of arsenic the patient should be instructed to watch carefully for the first untoward manifestations, such as puffiness about the eyes, itching of the conjunctivæ, nausea, diarrhea, or numbness of the fingers. Any one of these symptoms is an indication that the dose should not be increased; and it may be necessary to lessen the dose, or even to discontinue the remedy altogether, for a while.

There are two methods of getting a patient thoroughly under the influence of the drug:

1. Begin with a full dose of Fowler's solution, and decrease 1 minim (0.06 Cc.) a day until a 1-minim (0.06 Cc.) dose is reached; then repeat the method.

2. Begin with a small dose of Fowler's solution, and increase 1 minim (0.06 Cc.) a day until untoward symptoms appear or the dose has reached 10 to 15 minims (0.6–1.0 Cc.); then either repeat the method or decrease the amount 1 minim (0.06 Cc.) a day.

Cacodylates.—Organic compounds of arsenic are claimed to act much more slowly and less actively than the inorganic compounds. Such compounds are cacodylic acid and sodium cacodylate, which have been introduced into modern therapy, although first suggested by Schmidt in 1869. It is extensively claimed that these bodies are non-irritating, but this is not the fact, although clinical experience would seem to show that much larger doses of arsenic can be taken as cacodylates than in any other form. The indications are the same as those in ordinary arsenic therapy. Dosage, $\frac{1}{8}$–1 grain. Renz in 1865 obtained poisonous effects from doses of from 10 to 18 grains of cacodylic acid. French observers maintain that the hypodermic use of the cacodylates gives different results than when they are given by mouth.

Hydrărgyrum—Hydrărgyri—Mercury. *U. S. P.*

(QUICKSILVER.)

Origin.—The knowledge of this drug antedates the Christian era. It is found in Spain, Austria, Peru, and China, but is obtained principally from New Almaden, California. It occurs to some extent in the metallic state in the form of minute or large globules; also in combination with oxygen, chlorine, selenium, etc.; but the principal ore from which it is extracted is cinnabar.

Description and Properties.—A shining, silver-white metal, without odor or taste. It is liquid at the ordinary temperature, and easily divisible in spherical globules; but when cooled to—39.38° C. (—38.88° F.), it forms a ductile, malleable mass. Specific gravity, 13.535 at 25° C. (77° F.).

Insoluble in the ordinary solvents, also in concentrated hydrochloric acid, and, at common temperatures, in sulphuric acid, but dissolving in the latter when boiled with it, and readily and completely soluble in nitric acid. Mercury should be kept in strong, well-stoppered bottles.

Dose.—Mercury is seldom given internally except in the modified form of blue pill.

Official Derivatives.

Hydrărgyrum Ammoniătum—Hydrărgyri Ammoniăti—Ammoniated Mercury (U. S. P.).—*Origin.*—Prepared by mixing solutions of ammonia and corrosive mercuric chloride. Filter and wash the precipitated ammoniated mercury. It should contain not less than 78 per cent., nor more than 80 per cent., of metallic mercury.

Description and Properties.—White, pulverulent pieces, or white, amorphous powder, without odor, and having an earthy, and afterward styptic and metallic taste. Permanent in the air. Almost insoluble in water or in alcohol. It should be kept in well-stoppered bottles, protected from the light. Used externally.

Unguĕntum Hydrărgyri Ammoniăti—Unguĕnti Hydrărgyri Ammoniăti—Ointment of Ammoniated Mercury.—Formula: Ammoniated mercury, 10; white petrolatum, 50; hydrous wool-fat, 40. For external use.

Hydrărgyrum cum Crēta—Hydrărgyri cum Crēta—Mercury with Chalk (U. S. P.).—*Origin.*—Obtained by trituration of mercury, prepared chalk, clarified honey, and water.

Description and Properties.—A light-gray, rather damp powder, free from grittiness, without odor, and having a slightly sweetish taste. It contains 38 per cent. of mercury. This preparation should be kept in well-stoppered bottles, protected from light.

Dose, 3–10 grains (0.18–0.6 Gm.) [4 grains (0.25 Gm.), U. S. P.].

Măssa Hydrărgyri—Măssæ Hydrărgyri—Mass of Mercury (U. S. P.). (PILULA HYDRARGYRI—BLUE MASS—BLUE PILL).—Composed of mercury, glycyrrhiza, althæa, glycerin, and honey of rose.

Dose, 1/2–10 grains (0.03–0.6 Gm.) [4 grains (0.25 Gm.), U. S. P.].

Unguĕntum Hydrărgyri—Unguĕnti Hydrărgyri—Mercurial Ointment (U. S. P.).—Composition: Mercury, lard, suet, and oleate of mercury. Used externally.

Unguĕntum Hydrărgyri Dilūtum—Unguĕnti Hydrărgyri Dilūti—Blue Ointment (U. S. P.).—This preparation contains 67 per cent. of unguentum hydrargyri, which is called mercurial ointment. Heretofore "Blue Ointment" and "Mercurial Ointment" have been synonymous. Mercurial ointment contains about 50 per cent. of metallic mercury, while blue ointment contains about 33.5 per cent.

Emplăstrum Hydrărgyri—Emplăstri Hydrărgyri—Mercurial Plaster (U. S. P.).—Composition: Mercury, oleate of mercury, hydrous wool-fat, and lead plaster. Used externally.

Hydrărgyri Chlōridum Corrosīvum—Hydrărgyri Chlōridi Corrosīvi—Corrosive Mercuric Chloride (U. S. P.) (CORROSIVE CHLORIDE OF MERCURY—CORROSIVE SUBLIMATE).—*Origin.*—Prepared by heating a mixture of mercuric sulphate, sodium chlorate, and manganese dioxide. The corrosive chloride sublimes and is condensed. It should contain not less than 99.5 per cent. of pure mercuric chloride.

Description and Properties.—Heavy, colorless, rhombic crystals or crystalline masses; odorless and having an acrid and persistent metallic taste. Permanent in the air. Soluble in 13 parts of water, in 3 parts of alcohol, in 2 parts of boiling water, in 1.2 parts of boiling alcohol, in 4 parts of ether, and in about 14 parts of glycerin. It should be kept in well-stoppered bottles.

Dose.—1/64–1/8 grain (0.001–0.008 Gm.) [1/20 grain (0.003 Gm.), U. S. P.].

Hydrărgyri Chlōridum Mīte—Hydrărgyri Chlōridi Mītis—Mild Mercurous Chloride (U. S. P.) (CALOMEL—MILD CHLORIDE OF MERCURY).—*Origin.*—Obtained by triturating mercuric sulphate, mercury, sodium chloride, and boiling distilled water. Sublime, and wash the sublimed calomel with boiling distilled water. It should contain not less than 99.5 per cent. of pure mercurous chloride.

Description and Properties.—A white, impalpable powder, becoming yellowish-white on being triturated with strong pressure. It is odorless and tasteless, and permanent in the air. Insoluble in water, alcohol, or ether, and also in cold diluted acids. When strongly heated it is wholly volatilized, without melting. Calomel should be kept in dark, amber-colored bottles.

Dose.—1/32–10 grains (0.002–0.6 Gm.) [1–2 grains (0.065–0.125 Gm.), U. S. P.].

Pĭlulæ Cathărticæ Compŏsitæ—Pĭlulas (acc.) Cathărticus Compŏsitas—Compound Cathartic Pills.—*Dose,* 1 to 3 pills.

Hydrărgyri Iōdidum Flăvum—Hydrărgyri Iōdidi Flăvi—Yellow Mercurous Iodide (U. S. P.) (HYDRARGYRI IODIDUM VIRIDE—PROTIODIDE OF MERCURY—YELLOW (OR GREEN) IODIDE OF MERCURY).—*Origin.*—Prepared by mixing solutions of potassium iodide and mercurous nitrate with nitric acid and distilled water. The pre-

cipitate is washed and dried. It should contain not less than 99.5 per cent. of pure mercurous iodide.

Description and Properties.—A bright-yellow, amorphous powder, odorless and tasteless. By exposure to light it becomes darker in proportion as it undergoes decomposition into metallic mercury and mercuric iodide. Almost insoluble in water, and wholly insoluble in alcohol or ether. It should be kept in dark, amber-colored vials, with the least possible exposure to light.

Dose.—$\frac{1}{6}$–$\frac{1}{2}$ grain (0.01–0.03 Gm.) [$\frac{1}{6}$ grain (0.01 Gm.), U. S. P.].

Hydrărgyri Iōdidum Rūbrum—Hydrărgyri Iōdidi Rūbri—Red mercuric Iodide (U. S. P.) (BINIODIDE OF MERCURY—RED IODIDE OF MERCURY).—*Origin.*—Prepared by mixing solutions of corrosive mercuric chloride and potassium iodide; filter, and dry the precipitated red iodide. It should contain not less than 99.5 per cent. of pure mercuric iodide.

Description and Properties.—A scarlet-red, amorphous powder, odorless and tasteless; permanent in the air. Almost insoluble in water, but soluble in 130 parts of alcohol. It should be kept in well-stoppered bottles, protected from light.

Dose.—$\frac{1}{32}$–$\frac{1}{16}$ grain (0.002–0.004 Gm.) [$\frac{1}{20}$ grain (0.003 Gm.), U. S. P.].

Līquor Ărseni et Hydrărgyri Iōdidi—Liquōris Ărseni et Hydrărgyri Iōdidi—Solution of Arsenic and Mercuric Iodide.—(Described under *Arsenic.*)—*Dose,* 5 minims (0.3 Cc.), gradually increased.

Hydrărgyri Ŏxidum Flāvum—Hydrărgyri Ŏxidi Flāvi—Yellow Mercuric Oxide (U. S. P.).—*Origin.*—Prepared by precipitating a solution of corrosive mercuric chloride with soda. It should contain not less than 99.5 per cent. of pure yellow mercuric oxide.

Description and Properties.—A light orange-yellow, amorphous, heavy, impalpable powder; odorless, and having a somewhat metallic taste. Permanent in the air, but turning darker on exposure to light. Almost insoluble in water or in alcohol. It should be kept in well-stoppered bottles, protected from light. Not used internally.

Unguĕntum Hydrărgyri Ŏxidi Flāvi—Unguĕnti Hydrărgyri Ŏxidi Flāvi—Ointment of Yellow Mercuric Oxide.—Formula: Yellow mercuric oxide, 10; water, 10; hydrous wool-fat, 40; petrolatum, 40. Used externally.

Hydrărgyri Ŏxidum Rūbrum—Hydrărgyri Ŏxidi Rūbri—Red Mercuric Oxide (U. S. P.) (RED PRECIPITATE).—*Origin.*—Prepared by dissolving mercury in diluted nitric acid. Evaporate to dryness. Triturate the mercuric nitrate thus formed with mercury and heat. It should contain not less than 99.5 per cent. of pure red mercuric oxide.

Description and Properties.—Heavy, orange-red crystalline scales, or a crystalline powder, becoming yellower the finer it is divided; odorless, and having a somewhat metallic taste; permanent in the air. Almost insoluble in water and in alcohol. It should be kept in well-stoppered bottles, protected from light.

Dose.—$\frac{1}{64}$–$\frac{1}{10}$ grain (0.001–0.006 Gm.).

Unguĕntum Hydrărgyri Ŏxidi Rūbri—Unguĕnti Hydrărgyri Ŏxidi Rūbri—Ointment of Red Mercuric Oxide.—Formula: Red mercuric oxide, 10; water, 10; hydrous wool-fat, 40; petrolatum, 40. Used externally.

Līquor Hydrărgyri Nitrātis—Liquōris Hydrărgyri Nitrātis—Solution of Mercuric Nitrate (U. S. P.).—A liquid containing about 60 per cent. of mercuric nitrate, together with about 11 per cent. of free nitric acid.

Description and Properties.—A clear, nearly colorless, heavy liquid, having a faint odor of nitric acid and a strongly acid reaction. The product should be kept in glass-stoppered bottles.

Used externally as a caustic.

Unguĕntum Hydrărgyri Nitrātis—Unguĕnti Hydrărgyri Nitrātis—Ointment of Mercuric Nitrate (U. S. P.) (CITRINE OINTMENT).—Formula: Mercury, 70; nitric acid, 175; lard, 760 parts. Used externally.

Unofficial Preparations.

Lōtio Flāva—Lotiōnis Flāvæ—Yellow Wash.—Corrosive sublimate, 25 grains (0.5 Gm.), in lime water, 16 ounces (473.17 Cc.). For external use.

Lōtio Nīgra—Lotiōnis Nīgræ—Black Wash.—Calomel, 64 grains (4.15 Gm.), in lime water, 16 ounces (473.17 Cc.). For external use.

Aspăragin Hydrărgyrate.—*Dose.*—$\frac{1}{6}$ grain (0.01 Gm.), hypodermically.

Antagonists and Incompatibles.—Mercury with chalk is incompatible with acids and acidulous salts. Calomel is incompatible with alkalies, alkaline earths, alkaline carbonates, iron, lead, copper, iodine, bromides, soaps, sulphydrates, and nitrohydrochloric acid, as well as hydrochloric acid, potassium, ammonium, and sodium chloride.

Corrosive sublimate is incompatible with alkalies and their carbonates, soap, lime water, tartar emetic, the iodides of potassium and sodium, acetate of lead, silver nitrate, the sulphides, albuminous liquids (as milk, etc.), many vegetable infusions, and compound syrup of sarsaparilla.

In general, metallic preparations of mercury are incompatible with iodine and the chlorides.

Synergists.—Potassium iodide enhances the antisyphilitic action of mercury. Depressants—such as antimony and alkalies—increase the physiological activity of mercury and its preparations.

Tonic and resin-bearing purgatives—such as aloes, rhubarb, and podophyllum—aid the cathartic action of some of the mercurial preparations.

Physiological Action.—*Externally and Locally.*—Most of the preparations applied to the skin are antiparasiticide and antiseptic, corrosive mercuric chloride being one of the most important antiseptics and universal germicides known.

Some of the mercurials are powerful irritants, the nitrate being an active caustic. The mercurous salts even possess slightly stimulating properties.

Metallic mercury and its salts are readily absorbed with the aid of friction, at times producing a slight irritation resulting from their stimulating properties. Absorption may also take place from local application in the form of a fine vapor.

The introduction of the drug into the system through the medium of the skin is attended with all the symptoms of mercurial poisoning. The local actions of the various preparations differ somewhat, yet they agree in certain physiological effects produced after absorption of the drug.

Locally, on mucous membranes, mercury acts as an astringent or cauterizant, according to the salt used and the grade of concentration. The mercury ion has a marked affinity for albumin, coagulating it. The coagulum is usually light and flocculent, and the action of the metal is thus made more penetrating. In contact with mucous membranes an albuminate is formed which is very soluble in an excess of proteid. Thus absorption is rapid.

Internally.—Digestive System.—The action of the soluble and insoluble salts is distinct. The line between physiological action and toxic action is difficult to draw. The soluble salts are, even in minute doses, somewhat astringent or even corrosive. In larger doses they are powerfully escharotic. The action of soluble salts of mercury is to slightly inhibit the digestive processes. The insoluble salts are slightly irritating and cause increased peristalsis, and in-

creased secretions. They have little action on the digestive ferments.

Circulatory System.—Mercury in small doses has little action on the heart or vessels. The blood-making organs are stimulated by small doses, resulting in an increase of hemoglobin and of red cells. In lower animals a pseudo-antitoxic power has been demonstrated. Physiological stimulation soon passes over into toxic action with cachexia, leucocytosis, and other poisonous symptoms (*q. v.*).

Nervous System.—Tonic doses have little effect. There may be some erethism, muscular tremor, and slight peripheral signs preceding the development of more distinct toxic effects.

Respiratory System.—Small doses are not known to affect the respiratory action.

Excretion and Secretion.—The kidney epithelium is somewhat irritated by mercury. Diuresis is common.

The absorption of mercury is gradual; yet, notwithstanding the fact that every secretion of the body contributes to its general expulsion from the system, its cumulative action is a well-established fact.

Elimination occurs chiefly by the urine, the saliva, bile, sweat, milk, and feces. Even the semen shares in the process. Single doses may be eliminated in twenty-four hours, but the drug has been detected in the liver a year after the discontinuance of prolonged treatment. Mercury has been found in serum and in pus from ulcers. After death the kidneys and liver contain the largest amounts of the metal.

Untoward Action.—Many affections of the skin manifest themselves after the exhibition of mercury, *erythema* and *eczema* (eczema mercuriale) frequently occurring after either the ingestion or the external application of mercurial preparations.

In certain persons having an idiosyncrasy regarding this drug, extreme salivation and stomatitis may be induced by the internal use or the external application of mercurial preparations in medicinal quantities.

Medicinal doses may produce, in susceptible persons, marked disturbances of nutrition, sensation, and motion to such a degree as to suggest poisoning.

Poisoning.—Although mercury in a metallic state is comparatively innocuous, its vapor is capable of producing violent and dangerous symptoms. All the salts are active poisons, especially that known as corrosive sublimate. There are great variations in the grades of poisoning by mercury, and careful attention to its idiosyncrasies should not be overlooked. Poisoning may be divided into the acute and chronic varieties.

Acute Poisoning.—This is not as common a form of poisoning at present as in former days, because of the intensely acrid character of the mercury salts. There is usually a burning, metallic taste, whitish precipitate on the gums, with nausea and vomiting. Shreds of bloody stomach mucosa are frequently stripped off. Intense

colicky pains are developed with diarrhea, which is often bloody or watery, and with much tenesmus; symptoms of collapse, such as cyanosis, cold skin, small, rapid pulse (150 or over), irregular rapid respiration. Sometimes giddiness, sometimes unconsciousness, may develop. Frequently there is anuria, or bloody and albumin-filled urine. Death occurs usually from shock, and has resulted from $\frac{1}{8}$ grain of corrosive sublimate in one to two hours. Occasionally death takes place after several days with the development of the symptoms of chronic poisoning. A form of rapid poisoning occurs from the inhalation of mercury containing vapors, as in mirror factories. Workers on hat feltings often suffer.

Chronic Poisoning.—This may result from a single dose, but more often from prolonged small dosage, from the breathing of vapors containing mercury. The prodromal symptoms occur in the mouth. They are metallic taste, soreness of teeth, fetid breath, spongy, inflamed gums, and salivation. Discontinuance of the mercury and mouth hygiene usually clears up these symptoms. If, however, dosage is continued or rules of cleanliness neglected, the tongue may become swollen; there is extreme salivation with marked fetor; ulceration and bleeding may take place, and the mouth gets in an abominable condition, with loose teeth or even jaw necrosis. Other concomitant symptoms may develop, such as anorexia, nausea, colic, diarrhea, constipation, sometimes a distinct febrile movement of the temperature (secondary infections). Emaciation, cachexia, motor weakness, restlessness, may come on. There is frequently a fine muscular tremor, and later paresthesiæ, anesthesiæ, and paralysis may develop. Skin eruptions are not infrequent.

Treatment of Poisoning.—In acute poisoning from corrosive sublimate or other active salt of mercury it is necessary to evacuate the stomach as quickly as possible and give white of eggs freely. The after-treatment is similar to that of other corrosive poisons—the use of demulcents and opiates.

For salivation, potassium chlorate probably occupies the first place as a prophylactic and curative agent. It is employed as a gargle and mouth-wash, in a 2 to 3 per cent. solution. An astringent wash is frequently necessary. Such drugs as tannin, myrrh, krameria, etc., may be used for this purpose. Where there is extensive ulceration of the mouth, disinfectant and antiseptic solutions will be found desirable.

In cases of chronic mercurial poisoning it is of primary importance to remove all traces of the drug from the body by means of iodides, the dosage being limited in quantity, but continued for some time. A change of air, liberal and nutritious diet, and tonics are also necessary.

Therapeutics.—*Externally and Locally.*—As a germicide, antiseptic, and antiparasitic the preparations of mercury are extremely valuable; the corrosive chloride of mercury being extensively employed as an antiseptic in general surgery in strengths of from

1 : 1000 to 1 : 10,000. It attacks the fingers and instruments, and is not always a reliable germicide.

In *diseases of the skin* due to animal or vegetable parasites there are no drugs so valuable as certain preparations of mercury, the ointment of ammoniated mercury being highly prized.

CALOMEL in the form of an ointment, 5 to 20 grains (0.3–1.25 Gm.) to 1 ounce (32.0 Gm.) is an efficient remedy in *eczema.*

Indolent *venereal ulcers* are much improved by dusting them with calomel, while the early inflammatory conditions of these sores may be greatly benefited by the use of black wash.

Many diseases of the *eye*, *ear*, *nose*, and *throat* yield to various preparations of mercury. The ointment of the YELLOW OXIDE OF MERCURY is particularly adapted to *phlyctenular ophthalmia*, *pannus*, *keratitis*, *chronic blepharitis marginalis*, etc.

Inunction with MERCURIAL OINTMENT or with OLEATE OF MERCURY is excellent for the constitutional treatment of the first and second stages of *syphilis.* These two preparations are of great value in *subacute synovitis*, *pelvic cellulitis*, and *syphilitic orchitis* and *epididymitis.*

The OINTMENT OF THE RED IODIDE OF MERCURY has a reputation as an efficient remedy in *goiter* and *syphilitic enlargement of the spleen*, as well as in *pachymeningitis.*

The SOLUTION OF NITRATE OF MERCURY is an active and reliable caustic in the treatment of *phagedenic ulcerations* and *venereal ulcerations of the os uteri.*

The use of mercurials is usually attended with excellent results in promoting resolution of fibrous induration resulting from chronic inflammation.

Internally.—The principal use of mercury is undoubtedly as an antisyphilitic. Mercury is an antidote against *constitutional syphilis*, being particularly efficient in the secondary stage. Many methods of mercurializing a patient have been adopted, mention of which will be made under "Administration." It is perhaps unnecessary to caution the therapeutist to make an accurate and positive diagnosis of syphilis before instituting the mercurial treatment, as otherwise the consequences may be disastrous.

Mercury has been used in all stages of the disease, though, possibly from ignorance of its proper use, its employment has met with less favorable results in the primary than in the secondary form, while a careful study of syphilology leads one to believe that in tertiary syphilis it is inferior to the iodides. Many patients, however, do better under mercury than they do under the iodides.

The medical uses of mercurial preparations in disorders of the alimentary tract are very numerous.

Chronic dysentery will frequently yield to $\frac{1}{100}$ to $\frac{1}{60}$ grain (0.0006–0.001 Gm.) of CORROSIVE CHLORIDE OF MERCURY, and *diarrheas* of children—particularly those characterized by pale, offensive stools—together with *ileo-colitis* of infants, are greatly benefited by small doses of CALOMEL OR GRAY POWDER.

As a purgative in *bilious attacks*, *hepatic congestion*, and *cirrhosis* CALOMEL is an extremely valuable drug. Its action as a purgative will be more fully described under "Cathartics." Calomel is also a remarkably efficient diuretic, especially when combined with digitalis.

Many acute febrile and inflammatory conditions, such as *meningitis*, *pericarditis*, and *hepatitis*, are sometimes benefited by the internal administration of calomel, though in acute inflammations the chief value of the drug, whether specific or non-specific, is manifest in *iritis* and in *acute bronchitis* which shows a tendency to persist.

Calomel given early in from 10- to 20-grain (0.6–1.3 Gm.) doses in cases of *pneumonia* is esteemed very highly by some authorities.

Calomel and opium have been used and recommended by some physicians in the treatment of *Asiatic cholera*. In *chlorosis* and *marasmus of infants* very small doses of corrosive mercuric chloride, $\frac{1}{120}$ to $\frac{1}{100}$ grain (0.0005–0.0006 Gm.) have proved very beneficial in many cases.

Contraindications.—Mercury is usually contraindicated in *tuberculosis* and in persons of *strumous diathesis;* and while it is of value when judiciously employed in *chronic interstitial nephritis*, it must nevertheless be given cautiously, and if the excretion of urine is diminished by its use, the drug should be immediately discontinued.

Children, though not easily salivated, are very susceptible to other poisonous actions of calomel.

Ordinarily, *acute asthenic diarrhea* and *dysentery* in adults would contraindicate the use of mercurials.

Administration.—Mercury is introduced into the system by—

1. *Inunction.*—The portion of the body upon which the preparation is to be applied should first be thoroughly washed with soap and warm water, and the ointment well rubbed in with the palm of the hand. The best localities for application are the inner sides of the thighs, the sides of the chest, the axillæ, abdomen, and back. An excellent way to mercurialize a child is to put the ointment on the abdomen, beneath a flannel binder. An efficient means also of favoring absorption is to apply the ointment to the soles of the feet, when it will be rubbed in by walking. Mercurial ointment is ordinarily used for this purpose, 15 to 30 grains (1.0–2.0 Gm.) being required for each inunction. Oleate of mercury when applied externally should not be rubbed in, the simple application to the skin being sufficient.

2. *Fumigation.*—The iodide, mercuric sulphide, and calomel are used in this manner. The latter preparation, being preferable, is the one ordinarily used. From 5 to 20 grains (0.3–1.3 Gm.) of calomel are put in a plate or a porcelain dish over a lighted spirit-lamp. These are placed under a cane-bottomed chair, in which the patient sits, nude, enveloped in a blanket reaching to the floor and fastened loosely about the neck. The calomel is volatilized by the heat, deposited in minute particles over the surface of the body, and

readily absorbed. The fumigation should last fifteen to twenty minutes.

3. *Endermically.*—Mercurials may be absorbed by dusting calomel and certain other preparations on ulcers, open wounds, etc.

4. *By the Rectum.*—Mercury may be administered in the form of a suppository containing 5 to 10 grains (0.3–0.6 Gm.) of mercurial ointment.

5. *Hypodermically.*—From $\frac{1}{12}$ to $\frac{1}{6}$ grain (0.005–0.01 Gm.) of the bichloride of mercury, dissolved in 5 to 10 minims (0.3–0.6 Cc.) of distilled water, is injected deeply into the muscles of the gluteal region or in the subcutaneous areolar tissue of the back. The solution of peptonate of mercury has been used for this purpose, though the preparation which is the least objectionable is the solution of the formamidate of mercury, 16 minims (1.0 Cc.), corresponding to $\frac{1}{6}$ grain (0.1 Gm.) of mercuric chloride.

Numerous preparations have been recommended for hypodermic use. Many of them are of service, but space does not permit of their individual consideration. Cypridol is an excellent preparation.

6. *Internally.*—In the treatment of *syphilis* nearly every preparation of mercury has been employed, authorities differing in their choice. Bumstead prefers the bichloride, the mercurous iodide, and the mercurial pill; Berkeley Hill, the red mercuric iodide; Fox, the cyanide; Hutchinson, the gray powder, etc. It matters little which of these preparations is used. That which agrees best with the patient is advisable. Calomel, gray powder, blue pill, and corrosive sublimate are ordinarily used in disorders of the alimentary tract. As a rule, the first two are preferable.

IODINE AND THE IODIDES.

Iōdum—Iōdi—Iodine. *U. S. P.*

Origin.—It is found in the ashes of sea-weeds, and is prepared from the mother liquor obtained in the purification of Chili saltpetre.

Description and Properties.—Heavy, bluish-black, dry and friable, rhombic plates, having a metallic luster, a distinctive odor, and a sharp and acrid taste. It imparts a deep-brown, slowly evanescing stain to the skin, and gradually destroys vegetable colors. Iodine is soluble in about 5000 parts of water and in 10 parts of alcohol, with a brown color; also freely soluble in ether and in a solution of potassium iodide, with a brown color, and in chloroform or carbon disulphide, with a violet color. It should be kept in glass-stoppered bottles, in a cool place,

Dose.—About ¼ grain (0.016 Gm.) [$\frac{1}{10}$ grain (0.005 Gm.), U. S. P.], although seldom given in substance.

Official Preparations.

Līquor Iōdi Compŏsitus—Liquōris Iōdi Compŏsiti—Compound Solution of Iodine (LUGOL'S SOLUTION).—Iodine, 5; potassium iodide, 10; distilled water, to make 100 parts. Strength, 5 per cent.

Dose.—1–10 minims (0.06–0.6 Cc.) [3 minims (0.2 Cc.), U. S. P.].

Tinctūra Iōdi—Tinctūræ Iōdi—Tincture of Iodine.—Iodine, 70; alcohol, to 1000. Strength, 7 per cent.

Dose.—1–5 minims (0.06–0.03 Cc.) [1½ minims (0.1 Cc.), U. S. P.].

Unguĕntum Iōdi—Unguĕnti Iōdi—Iodine Ointment.—Iodine, 4; potassium iodide, 4; glycerin, 12; benzoinated lard, 83. Strength, 4 per cent. For external use.

Ăcidum Hydriōdicum Dilūtum—Ăcidi Hydriōdici Diluti—Diluted Hydriodic Acid. *U. S. P.*

Definition.—A solution of hydriodic acid, HI, containing not less than 10 per cent. by weight of the absolute acid, and about 90 per cent. of water.

Description and Properties.—A clear, colorless liquid, odorless, and having an acid taste. It should not become colored on keeping. Miscible in all proportions with water or alcohol. In the present preparation there is a small quantity of hypophosphorous acid. This acts as a preservative by reducing any iodine set free to hydriodic acid. The method of preparing it (for which see the Pharmacopœia) is that recommended in the 1890 U. S. Pharmacopœia in connection with the preparation of Syrupus Acidi Hydriodici; the latter is now prepared from the Acidum Hydriodicum Dilutum. The method is simple and requires no special apparatus or chemicals (Hunt).

Dose.—Average dose: 8 minims (0.5 Cc.), U. S. P.

Caution.—Should be kept in small, amber-colored, glass-stoppered bottles, protected from the light.

Sўrupus Ăcidi Hydriŏdidi—Sўrupi Ăcidi Hydriŏdidi—Syrup of Hydriodic Acid. *U. S. P.*

A syrupy liquid containing about 1 per cent. by weight of absolute hydriodic acid.

Description and Properties.—A transparent, colorless, or only pale-straw colored liquid, odorless, and having a sweet and acidulous taste.

Dose.—½–2 fluidrams (2.0–8.6 Cc.) [1 dram (4 Cc.), U. S. P.].

Ammōnii Iōdidum—Ammōnii Iōdidi—Ammonium Iodide. *U. S. P.*

Origin.—It is prepared by dissolving potassium iodide and ammonium sulphate in boiling water, adding alcohol, filtering, washing the filtrate, and evaporating it to dryness.

Description and Properties.—Minute, colorless, cubical crystals, or a white, granular powder, without odor when colorless, but emitting a slight odor when colored, and having a sharp, saline taste. The salt is hygroscopic, and soon becomes yellow, or yellowish-brown, on exposure to the air and light, owing to the loss of ammonia and the elimination of iodine. Soluble in 0.6 part of water and in 9 parts of alcohol. Ammonium iodide should be kept in small, well-stoppered vials, protected from light.

Dose.—3–20 grains (0.18–1.2 Gm.) [4 grains (0.25 Gm.), U. S. P.].

Potăssii Iōdidum—Potăssii Iōdidi—Potassium Iodide. *U. S. P.*

Origin.—Iodine is dissolved in a solution of potassa in hot distilled water. The solution is evaporated, and the residue heated with charcoal. Dissolve in boiling water, filter, wash the filtrate, and crystallize.

Description and Properties.—Colorless, transparent or translucent, cubical crystals, or a white, granular powder, having a peculiar, faint, iodine-like odor, and a pungent, saline, and afterward bitter taste. Permanent in dry air and but slightly deliquescent in moist air. Soluble in 0.7 part of water and in 12 parts of alcohol; also soluble in 2.5 parts of glycerin. Potassium iodide should be kept in well-stoppered bottles.

Dose.—2–30 grains (0.12–2.0 Gm.) [7½ grains (0.5 Gm.), U. S. P.].

Official Preparation.

Unguĕntum Potăssii Iŏdidi—Unguĕnti Potăssii Iŏdidi—Ointment of Potassium Iodide.—Potassium iodide, 10; potassium carbonate, 0.6; water, 10; benzoinated lard, 88. For external use.

Sōdii Iōdidum—Sōdii Iōdidi—Sodium Iodide. *U. S. P.*

Origin.—Prepared from a solution of soda in a manner similar to the preparation of potassium iodide.

Description and Properties.—Colorless, cubical crystals, or a white, crystalline powder, odorless, and having a saline and slightly bitter taste. In moist air it deliquesces and becomes partially decomposed into sodium carbonate and free iodine, assuming thereby a reddish color. Soluble in 0.5 part of water and in about 3 parts of alcohol. It should be kept in well-stoppered bottles.

Dose.—2–30 grains (0.12–2.0 Gm.) [7½ grains (0.5 Gm.), U. S. P.].

Strŏntii Iōdidum—Strŏntii Iōdidi—Strontium Iodide. *U. S. P.*

Origin.—Prepared by neutralizing freshly prepared solution of hydriodic acid with strontium carbonate, concentrating the filtrate, and crystallizing.

Description and Properties.—Colorless, transparent, hexagonal plates, odorless, and having a bitterish, saline taste; deliquescent and colored yellow by exposure to air and light. Soluble in 0.5 part of water, also soluble in alcohol, and slightly in ether. It should be kept in dark, amber-colored, glass-stoppered vials.

Dose.—2–30 grains (0.12–2.0 Gm.) [7½ grains (0.5 Gm.), U. S. P.].

Zĭnci Iōdidum—Zĭnci Iōdidi—Zinc Iodide. *U. S. P.*

Origin.—Obtained by dissolving zinc oxide or carbonate in hydriodic acid, or digesting granulated zinc in 10 parts of iodine and 20 parts of water, and evaporating to dryness.

Description and Properties.—A white, granular powder, odorless, and having a sharp, saline, and metallic taste. Very deliquescent, and liable to absorb oxygen from the air and to become brown from liberated iodine. Readily soluble in water, alcohol, or ether. Zinc iodide should be kept in small, glass-stoppered bottles.

Dose.—1–3 grains (0.06–0.18 Gm.) [1 grain (0.65 Gm.), U. S. P.].

Sŭlphuris Iōdidum—Sŭlphuris Iōdidi—Sulphur Iodide. *U. S. P.*

Origin.—Prepared by heating washed sulphur and iodine in a flask until the ingredients combine.

Description and Properties.—Brittle masses, of a crystalline fracture and a grayish-black, metallic luster, having the odor of iodine and a somewhat acrid taste. Almost insoluble in water; soluble in about 60 parts of glycerin; very soluble in carbon disulphide. Alcohol and ether dissolve out the iodine, leaving the sulphur. Sulphur iodide should be kept in glass-stoppered bottles, in a cool place.

Dose.—1–5 grains (0.06–0.3 Gm.).

Plŭmbi Iōdidum—Plŭmbi Iōdidi—Lead Iodide. *U. S. P.*

See *Lead*.

Other compounds of iodine, used internally, are numerous. Some of those more recently brought to the practitioner's attention are: *Iodic acid* and its compound; *iodine tribromide; iodine trichloride; iodopin*, a compound of sesame oil and iodine, recommended as alterative; *iodo-albumin; iodophenine*, a combination of iodine and phenacetine, used in rheumatism in 8-grain doses; *iodopyrine*, an analogous compound; *iodotheine* (iodine and theine), a heart stimulant; *iodotheobromin*, analogous to the last, and *iodothyrin* (see under *Thyroid Extract*).

Antagonists and Incompatibles.—Iodine is incompatible with the alkaloids and most of the mineral salts and acids, and with

ammonia. The iodides are incompatible with mineral acids and acid salts, bismuth subnitrate, alkaloids, silver nitrate, soluble lead salts, spirit of nitrous ether, potassium chlorate, licorice, and preparations containing starch. The tincture of iodine is incompatible with water and aqueous preparations.

Synergists.—Water, alkalies, and remedies increasing tissue waste.

Physiological Action.—*Externally and Locally.*—Iodine is a powerful disinfectant and rubefacient, as well as vesicant, caustic, parasiticide, and antiseptic. When applied to the skin or mucous membrane it produces a yellow, brown, or black stain, and is irritant or caustic, according to the strength and frequency of the application. The discoloration, however, can be easily removed by sodium hyposulphite or ammonia.

It combines with the albumin of the tissues and prevents putrefactive changes. When tincture of iodine is frequently applied or large amounts are used, desquamation of the skin is produced, and sometimes rapid vesication, or perhaps sloughing. The blood-vessels of the organs subjacent to the area to which it is applied are reflexly dilated, rendering this drug an efficient counterirritant.

The vapor of iodine when inhaled produces considerable irritation of the respiratory passages, exciting cough, sneezing, increased secretion of mucus, dyspnea, and more or less pain in the chest, although when inhaled in moderate amounts its antiseptic properties exert a beneficial influence upon the bronchial tissues, preventing decomposition of the secretions.

The iodides have little local action.

Internally.—*Digestive System.*—Taken internally in small doses, IODINE acts as a gastric tonic, minute doses acting as a sedative, allaying nausea. In other cases a single moderate dose may occasion gastric uneasiness, larger amounts intensifying the discomfort and causing violent vomiting, increased salivary flow, abdominal pains, and purging.

The IODIDES in moderate doses produce a sense of warmth in the stomach, larger amounts acting like iodine, though less irritating to the gastro-intestinal tract than the latter drug.

Owing to their rapid diffusibility, the iodides can be tasted in a few minutes after their ingestion, considerably increasing the flow of saliva.

Circulatory System.—The effects of iodine and its salts have been variously reported, it being claimed that their tendency is to contract the vessels and cause increased cardiac action. Introduced into the veins, a slight increase, followed by decrease of pressure, has been observed. The rapidity of elimination from the blood is doubtless an impediment to any marked action on the circulation. Trasbot claims that potassium iodide dilates the blood-vessels, thereby increasing glandular secretion.

The iodides are all supposed to be converted into the sodium iodide in the blood, without modifying the composition of that fluid.

They probably form a loose combination with proteids.

Nervous System.—No special action is recorded, although the potassium iodide is known to occasion unpleasant symptoms, including distress of mind and depression of spirits, accompanied now and then by lassitude and muscular debility—symptoms due rather to the influence of potassium.

Respiratory System.—Little or no effect from medicinal doses has been noted.

Absorption and Elimination.—Iodine and the iodides are rapidly absorbed by the mucous membranes generally, being found in the blood, mainly in combination with proteids.

Elimination takes place by various channels—the urine, saliva, milk, intestinal and nasal mucous membranes. Salivary elimination appears to be even more active than the urinary process, although the drug escapes largely through the kidneys, increasing the amount of water, urea, uric, phosphoric, and sulphuric acids excreted. At the points of elimination the iodine is thought to escape in its nascent state, thus occasioning more or less irritation, and accounting for the symptoms of iodism.

It should be borne in mind that iodine, as iodothyrine, is a normal constituent of the thyroid gland and in all probability the action of iodine in the body is conditioned very largely by the functioning of the thyroid and parathyroid glands. Certainly the action of the iodides on metabolism has some such relationship.

Temperature.—Slight rises in temperature have been noted from prolonged dosage, possibly a reflex from the irritation of the skin, or an infection.

Eye.—Beyond a local congestion of the minute vessels of the sclerotic coat under certain conditions, little effect has been observed. The symptoms of ocular iodism at times present are described under "Poisoning."

Uterus.—Small doses may increase or hasten the menstrual flow and act as aphrodisiacs; larger doses have a marked anaphrodisiac effect; while prolonged administration may result in atrophy of the ovaries. It has been maintained with authority that the catamenia are liable to increase, and that during pregnancy the drug may cause abortion.

Untoward Action.—The untoward manifestations, in susceptible patients, are identical with those of iodism.

Poisoning.—Taken in excessive doses, iodine acts as a poison, and has even produced death, though rarely. The symptoms of acute poisoning are those of severe gastro-enteritis, characterized by distressing stomachic and abdominal pains, accompanied by painful irritation of the esophagus, followed by violent purging and vomiting.

An early symptom is a strong metallic taste in the mouth, together with increased salivation. Suppression of urine, hiccough, and dysenteric pain have been reported in a fatal case resulting

from external application. Very immoderate doses are attended with rapid and feeble pulse, deathly pallor, severe renal irritation affecting urinary secretion, and final loss of vital power followed by respiratory failure.

The condition induced by prolonged or excessive use of iodine or its salts is known as *Iodism*. Together with a metallic taste there are present tenderness of the teeth and gums, nausea, and symptoms of gastric irritation.

Marked symptoms involving practically the entire respiratory mucous membrane, coryza, coughing, occasionally dyspnea, etc., this catarrh may extend to the conjunctivæ. The skin is always involved—acneiform eruptions—even a vesicular and purpuric variety not unfrequently occurs.

Moreover, muscular twitchings, edema of the glottis, neuralgic pains, and atrophy of mammæ, testicles, and other tissues occasionally supervene. Anemia and even cachexia are often manifest.

Treatment of Poisoning.—The use of large amounts of starch, in the form of arrowroot or starch-water, has been successfully adopted as an antidote. Hypodermic injections of ammonia, strychnine, digitalis, alcohol, and atropine have been employed with excellent results, as tending to restore the circulation and assist respiratory movements. More recently bicarbonate of sodium has proved an efficient antidote.

The use of the gastric siphon and the application of heat to the body and extremities are naturally of the first importance.

Therapeutics.—*Externally and Locally.*—The TINCTURE, COMPOUND SOLUTION, and OINTMENT are extensively employed as counterirritants and as aids to the absorption of fluid. The tincture is an efficient application to joints in *chronic rheumatism*, *gout*, and *synovitis*, and in *pleurisy*, both for the purpose of aborting an attack and to aid the absorption of fluid when effusion has taken place. In *neuritis*, *onychia*, *periostitis*, *venereal bubo*, *glandular swellings*, etc., the tincture, applied externally, will often be of service. Combined with tincture of aconite, equal parts, a useful application to sore gums is secured. The TINCTURE OF IODINE has been recommended as an efficient application in recession of the gums attendant upon *pyorrhea alveolaris*.

This same preparation is of marked benefit when hypodermically injected in *goiter*, particularly of the soft or cystic variety, *hydrocele*, *empyema*, *extensive serous arthritic effusion* unaccompanied by inflammation, *spinal meningocele*, and *anal fistula*.

The tincture is also a very efficient application in *chronic metritis* and *chronic endometritis*.

In many diseases of the skin iodine serves a useful purpose as a discutient and parasiticide, *lentigo*, *lupus*, *chloasma*, *tinea tonsurans*, etc., especially indicating its use.

The vapor of iodine is frequently employed in subacute *catarrhal deafness* and in *acute coryza*.

A mixture of tincture of iodine ½ fluidrachm (2.0 Cc.), carbolic

acid 10 minims (0.6 Cc.), glycerin and water, each, 1½ ounces (45.0 Cc.), has been highly recommended by Samuel Johnston in the treatment of *chronic pharyngitis*.

As an inhalant in *chronic laryngitis* and *phthisis* iodine in some form is highly esteemed by many physicians.

Many iodine substituted derivatives are in active use as antiseptics. (see *Antiseptics*, *Iodoform*, etc.).

Internally.—One of the principal and most important uses of iodine and the iodides is in the treatment of secondary and tertiary *syphilis*. All the manifestations of this disease, such as *syphilitic periostitis*, *meningitis*, *endarteritis*, *gummata*, *paralysis*, etc., are relieved by large doses of the iodides to saturation of the system.

Iodine is peculiarly useful in combining with and eliminating mercury from the system of patients suffering from *mercurial cachexia*, *paralysis*, etc. Other metals—lead, etc.—are readily eliminated by a course of potassium iodide.

POTASSIUM IODIDE is of marked utility in arresting the various manifestations of *scrofula*, such as *inflammation* and *ulceration of cartilaginous structures* and *mucous catarrhs*, and hastening the resolution of *adenitis* and *enlargement of lymphatics*.

With regard to the use of iodide in the treatment of *aneurism of the aorta* Walshe says: "Not only has relief of neuralgic pains and of the general distress followed its administration, but the local pressure-symptoms have been mitigated, and firm thrombosis has taken place within the sac, while the area of pulsation and of percussion-dulness has exhibited sensible reduction." Other authorities have reported favorably of its use in this condition.

As cardiac tonics the iodides are of undoubted value, being especially serviceable in *fatty degeneration of the heart*, and for the mitigation of the symptoms of *chronic valvular diseases of the heart*, especially those of the aortic orifice. It is a particularly useful remedy in *chronic asthma* and *bronchitis*, and to hasten the removal of inflammatory products of *pueumonia*, *pleurisy*, and *pericarditis*.

The *spasmodic asthma* of adults and the *bronchitis* of children, both of which alternate with eczematous attacks, are greatly relieved by potassium iodide.

Even *hereditary asthma* occurs at less frequent intervals and in a milder form when the patient is kept constantly under the influence of moderate doses of this drug.

In the early stages of *cirrhosis*, whether of the liver or kidneys, potassium iodide is a useful remedy. The *dropsy* of *splenic* or *hepatic induration* is relieved by iodine, while in the various forms of *muscular rheumatism* it is one of the most potent medicaments. It has been advocated as a successful remedy in *sciatica* and *chronic gout*.

AMMONIUM IODIDE is highly recommended as an efficient remedy in acute *catarrhal pneumonia* and *capillary bronchitis*. It is especially useful in catarrhal jaundice, and has, moreover, been suggested as a good remedy in *hay fever*.

The SYRUP OF HYDRIODIC ACID has been commended by Craig as a valuable agent in *acute rheumatism*. Small doses of the *tincture of iodine* have been found efficient in the *vomiting of pregnancy*.

Contraindications.—The drug should be discontinued at once when symptoms of iodism appear. It is contraindicated also in pulmonary tuberculosis when there is a rapid change taking place in the lung. The iodides should not be given immediately before or after the administration of quinine.

Administration.—The sodium iodide is less active and toxic than the potassium salt. The strontium iodide may be used for the same purpose as the other iodides, and possesses the advantage of disturbing the stomach less, besides being less likely to produce iodism.

The iodides should be given in a large quantity of liquid. Their unpleasant taste may be concealed to a considerable extent by dissolving them in carbolic-acid water or Vichy water. Milk, compound syrup of sarsaparilla, and current and raspberry syrups have all been used for this purpose.

It is said that tincture of belladonna or sodium bicarbonate prevents the coryza caused by the iodides.

The syrup of hydriodic acid is more pleasant to the taste, and has but little tendency to produce iodism or untoward effects. This preparation should always be administered upon an empty stomach. The syrup of the iodide of wine is a useful combination in the cachexia of syphilis.

Cŏlchicum—Cŏlchici—Colchicum. *U. S. P.*

(MEADOW SAFFRON.)

Origin.—The dried corm and seed of *Colchicum autumnale*, known respectively as CŎLCHICI CORMUS and COLCHICI SEMINIS. A plant indigenous in Europe, in the southern and central portions of which it is frequently found in pastures and meadows, flowering in September or October, and ripening its seeds in June following. The corm and seeds are official.

Description and Properties.—The *corm* is about 1 inch (25 Mm.) long, ovoid, flattish, with a groove on one side; externally brownish and wrinkled, internally white and solid; often in transverse slices, reniform in shape, and breaking with a short, mealy fracture; inodorous; taste sweetish bitter, and somewhat acrid. It should contain not less than 0.35 per cent. of colchicine.

Dose.—2–8 grains (0.12–0.5 Gm.) in powder [4 grains (0.250 Gm.), U. S. P.].

Colchicum seeds are subglobular, about $\frac{1}{12}$ inch (2 Mm.) thick, very slightly pointed at the hilum; reddish-brown, finely pitted, internally whitish; very hard and tough; inodorous; taste bitter and somewhat acrid. They should contain not less than 0.55 per cent. of colchicine.

Dose.—1–5 grains (0.06–0.3 Cm.) [3 grains (0.2 Gm.), U. S. P.].

Both the corm (root) and seeds contain two alkaloid-like bodies, *colchicine* and *colchiceine*. These are closely related chemically. Colchiceine is said (Kionka) to be non-poisonous.

Official Preparation.

Colchicina — Colchicinæ — Colchicine, U. S. P. — *Definition.* — An alkaloid, $C_{22}H_{25}NO_6$, obtained from colchicum. Although classed with the alkaloids, colchicine has an acid reaction.

Character.—Pale-yellow leaflets or a pale-yellow amorphous powder, turning darker on exposure to light, having an odor suggesting damp hay, and a very bitter taste.
Solubility.—Soluble in water (1 : 22) and readily so in alcohol.
Incompatibility.—Colchicine is precipitated from solution by tannic acid.
Dose.—Average dose: $\frac{1}{128}$ grain (0.0005 Gm. = 0.5 milligramme), U. S. P.

Official Preparation of the Root.

Extrăctum Cŏlchici Cŏrmi—Extrăcti Cŏlchici Cŏrmi—Extract of Colchicum Corm.—*Dose*, ½–2 grains (0.03–0.12 Gm.).

Official Preparations of the Seed.

Fluidextrăctum Cŏlchici Sĕminis—Fluidextrăcti Cŏlchici Sĕminis—Fluidextract of Colchicum Seed.—*Dose*, 1–5 minims (0.06–0.3 Cc.), U. S. P.
Tinctūra Cŏlchici Sĕminis—Tinctūræ Cŏlchici Sĕminis—Tincture of Colchicum Seed.—*Dose*, 10–30 minims (0.6–2.0 Cc.).
Vīnum Cŏlchici Sĕminis—Vīni Cŏlchici Sĕminis—Wine of Colchicum Seed.—*Dose*, 10–30 minims (0.6–2.0 Cc.), U. S. P.

Antagonists and Incompatibles.—Alcohol and opium antagonize the cardiac depression produced by colchicum. Tannic acid and vegetable infusions containing it are incompatible with colchicine.

Synergists.—Diuretics, purgatives, emetics, potassium iodide, and alkalies promote the therapeutic activity of colchicum.

Physiological Action.—*Externally and Locally.*—Colchicum is a decided local irritant, and when applied to the skin acts as a rubefacient. The dust when inhaled excites sneezing.

Internally.—*Digestive System.*—In small medicinal doses colchicum slightly stimulates the salivary, gastric, biliary, and intestinal secretions. If these doses are repeated for several days, a sensation of heat is experienced in the epigastrium, accompanied by loss of appetite and frequently by nausea. Full medicinal doses may produce purging and colic. Larger doses occasion profuse watery and choleriform or bloody evacuations from the bowels, severe abdominal pain and tenderness, excessive vomiting—in fact, all the symptoms produced by a violent gastro-intestinal irritant.

Circulatory System.—Full medicinal or larger doses produce great depression of the circulation, with a small, rapid, and thready pulse. The marked cardiac depression and collapse which occur when poisonous doses of colchicum have been taken are more the result of the severe gastro-enteritis than of any direct action upon the heart.

Nervous System.—The nervous system is unaffected by medicinal doses. Even when poisonous doses have been taken the intellect usually remains unimpaired, though Toulmouche has seen the drug induce marked cerebral excitement. Discordant statements have been made regarding the action of colchicum upon the nervous system. The drug evidently affects different persons differently. Thus, numbness or prickling, muscular pains or spasms, and occasionally convulsions, have been noticed; yet the recent investigations of Houdé-Laborde upon the action of colchicine

show that it has no influence upon the centers of intelligence and volition, and does not induce paralysis of central origin, either motor or sensory, though the sensory nerves are considerably depressed.

Respiratory System.—Large or poisonous doses of colchicum render the respiratory movements slow and shallow. This action is not due to any direct effect upon the respiratory center—although Rossbach and Wehmer maintain the contrary—but reflexly to the depression occasioned by the violent action of the drug upon the gastro-intestinal tract.

Absorption and Elimination.—Colchicum is quite rapidly absorbed, and is eliminated chiefly by the bowels and kidneys, the skin sharing to some extent in the excretory process. Some observers allege that colchicum does not increase the amount of urine or the excretion of urea and uric acid, while others claim that these substances are increased.

Temperature.—Under moderate medicinal doses the temperature is unaffected, though doses large enough to produce emeto-catharsis are followed by a reduction of temperature.

Untoward Action.—Many symptoms described under *Poisoning*, have been produced by very small doses. It is a matter of speculation whether these untoward manifestations were due to a decided idiosyncrasy on the part of the patient, or to the fact that the preparation employed might have contained an unusually large percentage of the alkaloid. Recent studies point to the fact that colchicine may be oxidized in the body to oxydicolchicine, which is the active poison.

Poisoning.—The symptoms of poisoning by colchicum are violent vomiting and purging, griping and intense pain in the abdomen, precordial distress, and at times excesssive salivation, sweating, or possibly convulsions. The initial symptoms may be delayed two or three hours or even more. A great sense of depression is characteristic. This is followed by weakness of the muscles, those of the extremities seem to be partly paralyzed. While death is for a time delayed under a poisonous dose, a fatal termination is usual (90 per cent.). The patient suffers excruciatingly, being little relieved by treatment, and dies of respiratory paralysis in twenty-four to forty-eight hours. The minimum lethal dose of colchicine is 40 to 60 milligrams, up to 1 grain.

Treatment of Poisoning.—All that can be done is to combat symptoms, giving opium for pain, oil and demulcent drinks for the irritation, and stimulants to counteract respiratory and cardiac depression. Washing out the stomach or the use of emetics may be required. Tannic acid serves as a partial antidote, precipitating the colchicine.

Therapeutics.—*Externally and Locally.*—Colchicum has no local therapeutic action.

Internally.—Colchicum is valuable for *gout* in all its varied manifestations. *Diarrhea, dysentery, dyspepsia, bronchitis, asthma, neu-*

ralgia, and *eczema dependent upon a gouty condition* are singularly benefited by colchicum.

This medicine, while occasionally efficacious in *chronic rheumatism*, and occasionally of some benefit in *rheumatoid arthritis*, is of no value in acute articular rheumatism.

Its value is more apparent in acute, than in chronic, gout, and in the first attacks than in succeeding ones. Chronic gout, as well as chronic rheumatism, yields better to a combination of colchicum and potassium iodide than to colchicum alone.

In combination with certain other agents colchicum serves an excellent purpose as a cholagogue, full doses being frequently very effective in relieving *ascites* due to obstructive diseases of the liver. Salicylic acid or the salicylates are excellent adjuvants to colchicum in these conditions.

Colchicum is sometimes employed as a drastic purgative in *cerebral* and *portal congestion*, although when given in doses sufficient for this purpose it occasions considerable nausea and abdominal distress. It is unsafe in this connection.

In combination with certain other agents colchicum serves an excellent purpose as a cholagogue, full doses being frequently very effective in relieving *ascites* due to obstructive diseases of the liver.

Hypochondriasis resulting from renal insufficiency is frequently benefited by colchicum.

Contraindications.—The drug would be contraindicated in acute inflammatory conditions of the gastro-intestinal tract. It should be cautiously administered to old people.

Administration.—The liquid preparations are to be preferred, and, in order to secure the full curative effects of the drug, it is unnecessary to give it in doses sufficiently large to cause nausea. The initial dose, therefore, should be small, that it may occasion no gastric disturbance.

The beneficial effects of colchicum may be enhanced by first emptying the intestinal canal by means of a saline cathartic.

The preparations of colchicum vary greatly in strength. The crude drug contains different percentages of the alkaloid, according to the season of the year in which the plant is gathered. Owing to this variation the alkaloid is to be preferred, though, because of its activity, it should be given in very small doses at first.

Sarsaparilla—Sarsaparillæ—Sarsaparilla. *U. S. P.*

Origin.—The dried root of *Smilax medica* Chamisso and Schlechtendal, *Smilax ornata* Hooker, *Smilax papyracea* Duhamel, or a dried root known commercially as Honduras Sarsaparilla, which is probably obtained from *Smilax officinalis* Kunth.

The species of smilax grow in swampy forests in Mexico and as far south as the northern portion of Brazil. They are woody climbers, often attaining a great height.

Description and Properties.—About ⅛ to ¼ inch (3.17–6.35 Mm.) thick, very long, cylindrical, longitudinally wrinkled, externally grayish- or orange-brown; internally showing a whitish and mealy or somewhat horny cortical layer surrounding a circular wood-zone enclosing a broad pith; nearly inodorous; taste mucilaginous, bitterish, and acrid. The thick, woody, knotty rhizome, if present, should be removed.

Sarsaparilla contains an active principle, *parillin*, an acrid glucoside which froths

with water and otherwise closely resembles saponin in its action; it also contains *saponin* and *sarsa-saponin*, two glycosides, the latter of which is the most poisonous glycoside in the plant.

Dose.—30–60 grains (2.0–4.0 Gm.) [30 grains (2 Gm.), U. S. P.].

Official Preparations.

Fluidextrăctum Sarsaparĭllæ—Fluidextrăcti Sarsaparĭllæ—Fluidextract of Sarsaparilla.—*Dose*, ½–2 fluidrams (2.0–8.0 Cc.) [30 minims (2 Cc.), U. S. P.].

Fluidextrăctum Sarsaparĭllæ Compŏsitum—Fluidextrăcti Sarsaparĭllæ Compŏsiti—Compound Fluidextract of Sarsaparilla.—*Dose*, ½–2 fluidrams (2.0–8.0 Cc.) [30 minims (2 Cc.), U. S. P.].

Sȳrupus Sarsaparĭllæ Compŏsitus—Sȳrupi Sarsaparĭllæ Compŏsiti—Compound Syrup of Sarsaparilla.—A fluidextract, 20 per cent., with the fluidextracts of glycyrrhiza and senna, and the oils of sassafras, anise, and gaultheria.

Dose, 2–4 fluidrams (8.0–16.0 Cc.) [4 fluidrams (16 Cc.), U. S. P.].

Antagonists and Incompatibles.—Alkalies and free iodine are incompatible with the official preparations of sarsaparilla.

Synergists.—The alteratives, diaphoretics, and diuretics.

Physiological Action.—Sarsaparilla has no local influence. Internally its action is due to the saponins contained. These have been discussed elsewhere.

Therapeutics.—As with guaiac, the history of sarsaparilla is full of interest. Introduced into Europe in the sixteenth century by the Spaniards, who had learned of its alleged virtues in constitutional *syphilis* in Peru, San Domingo, and Brazil, it retained its reputation as a specific in this disease for a century or more, when it was abandoned, only to be revived at the close of the eighteenth century. Since that time it has retained its place in medicine more through the wonderful virtues ascribed to it by nostrum-venders than to any real medicinal properties which it possesses.

The consensus of competent opinion seems to be that sarsaparilla can claim no special medicinal virtues other than its diuretic and diaphoretic properties.

Contraindications.—There are none.

Administration.—No special directions can be given for the administration of the various preparations. The compound syrup of sarsaparilla is quite pleasant to the taste, and is used extensively as a vehicle, particularly for potassium iodide. The sarsaparilla of the soda-water fountain is a mixture of aromatics, principally sassafras and wintergreen. It has no relation to sarsaparilla.

Stillĭngia—Stillĭngiæ—Stillingia. *U. S. P.*

(Queen's Root.)

Origin.—The dried root of *Stillingia sylvatica* L., a perennial herb growing in dry and sandy soil in the Southern United States as far north as Eastern Virginia.

Description and Properties.—About 1 foot (30 Cm.) long and nearly 2 inches (5 Cm.) thick, subcylindrical, slightly branched, compact, wrinkled, tough, grayish-brown, breaking with a fibrous fracture, showing a thick bark and porous wood, inner bark and medullary rays having numerous yellowish-brown resin-cells. The odor is peculiar and unpleasant; the taste bitter, acrid, and pungent.

It contains an acrid resin, *sylvacrol*, a volatile and a fixed oil, starch, gum, tannin, and a glycoside.

Dose.—15–30 grains (1.0–2.0 Gm.).

Official Preparation.

Fluidextrāctum Stillīngiæ—Fluidextrācti Stillīngiæ—Fluidextract of Stillingia.—*Dose*, ¼–1 fluidram (1.0–4.0 Cc.) [30 minims (2 Cc.), U. S. P.].

Physiological Action.—The action of stillingia resembles that of sarsaparilla, the drug increasing the various secretions and stimulating the heart and circulation.

Guaīacum—Guaīaci—Guaiac. *U. S. P.*

Origin.—The resin of the wood of *Guaiacum officinale* L., or of *Guaiacum sanctum* L.

Description and Properties.—Irregular masses or subglobular pieces, externally greenish-brown, internally of a glassy luster, and in recent guaiac usually reddish-brown, transparent in thin splinters, fusible, feebly aromatic, the odor becoming stronger upon heating; taste somewhat acrid; powder grayish, turning green on exposure to air. Soluble in potassium or sodium hydrate T. S. and in alcohol, the alcoholic solution being colored blue by the addition of tincture of ferric chloride.

The principal constituents of guaiac resin are—guaiaconic acid, guaiacic acid, guaiaretic acid, and a small amount of gum. It also contains volatile oils. These substances are insoluble in water, but soluble in alkalies.

Dose.—5–30 grains (0.3–2.0 Gm.) [15 grains (1 Gm.), U. S. P.].

Official Preparations.

Tinctūra Guaīaci—Tinctūræ Guaīaci—Tincture of Guaiac.—*Dose*, 30–60 minims (2.0–4.0 Cc.) [1 fluidram (4 Cc.), U. S. P.].

Tinctūra Guaīaci Ammoniāta—Tinctūræ Guaīaci Ammoniātæ—Ammoniated Tincture of Guaiac.—*Dose*, 30–60 minims (2.0–4.0 Cc.) [30 minims (2 Cc.), U. S. P.].

Antagonists and Incompatibles.—Spirit of nitrous ether and the mineral acids are incompatible with guaiac. Water is pharmaceutically incompatible with the tinctures, precipitating the resin.

Synergists.—Many of the diaphoretics and diuretics and the vegetable alteratives aid the action of guaiac.

Physiological Action.—*Externally and Locally.*—Guaiac is antiseptic, and possesses mildly astringent properties, being used locally as a gargle.

Internally.—The action of guaiac resembles that of the drugs belonging to the volatile oil group. It is a stimulant to the digestive, circulatory, and respiratory systems.

Therapeutics.—*Externally and Locally.*—Guaiac in some form is an excellent application in *follicular tonsillitis*, *rheumatic pharyngitis*, and *quinsy*. For these cases the emulsion of guaiac serves as an efficient gargle, or the troches of guaiac may be used.

Internally.—From the sixteenth to the eighteenth century guaiac was renowned as a cure for *syphilis*, having been introduced into Europe from San Domingo. The heroic manner, however, in which the drug was employed rendered the results more injurious than beneficial, so that the guaiac treatment was condemned, one of its most vigorous opponents being Paracelsus, to whom the reintroduction of mercury for the treatment of syphilis is largely due. The drug possesses properties which render it valuable in *chronic muscular rheumatism*, *neuralgic dysmenorrhea*, and *atonic amenorrhea*.

Guaiac is considered to be an efficient remedy in *lumbago* and *chronic gout*. Its most important service, however, in therapeutics is in the treatment of *quinsy*. It is doubtful whether there is any drug which will modify the course of this disease or abort an attack of tonsillitis so readily as this medicine. The tincture of guaiac is the preparation usually employed for this purpose, ½ fluidrachm (2.0 Cc.) being given in the form of an emulsion every three or four hours.

Contraindications.—There are no marked contraindications to its use.

Administration.—The tinctures are very acrid and disagreeable to the taste, and should be given in the form of an emulsion. The emulsion of guaiac, a formula for which is given in the Dispensatories, is not unpleasant, and is altogether the best liquid preparation to give.

The lozenges of guaiac, allowed to dissolve slowly in the mouth, serve as an agreeable and efficient method of medicating the throat with this drug.

ACIDS—ALKALIES—SALTS.

ACIDS.

MINERAL ACIDS.

THERE are certain characteristics common to all the mineral acids which claim primary attention:

Concentrated mineral acids are caustic to a greater or less degree.

They combine with alkalies and alkaline earths to form salts, and unite with vegetable acids, setting them free from their combination with bases. When in contact with the tissues of the body they combine with the protoplasm, neutralizing the alkalies which the latter contains and forming mineral salts. They also combine with the albumin, forming acid albumin.

They diminish the functional activity of the muscular and nervous systems. Applied locally in a concentrated form, or taken internally in poisonous doses, they tend to produce rigidity of the muscles by coagulating the myosin.

The alkalinity of the blood is lessened, ammonia and the fixed alkalies of the blood and cells being called on to counteract the action of the acid, and the acidity of the urine is increased by the internal administration of practically all of the mineral acids.

They increase the secretion from alkaline glands and lessen the secretion from acid glands.

Ăcidum Hydrochlōricum—Ăcidi Hydrochlōrici—Hydrochloric Acid. *U. S. P.*

(MURIATIC ACID).

Origin.—A liquid composed of 31.9 per cent. by weight of absolute hydrochloric acid (HCL = 36.38) and 68.1 per cent. of water.

Description and Properties.—A colorless, fuming liquid, of a pungent odor and an intensely acid taste. Fumes and odor disappear on diluting the acid with 2 volumes of water. Specific gravity about 1.098 at 25° C. (77° F.). Miscible in all proportions with water and alcohol. Hydrochloric acid should be kept in dark, amber-colored, glass-stoppered bottles.

Official Preparations.

Acidum Hydrochlōricum Dilūtum—Ăcidi Hydrochlōrici Dilūti—Diluted Hydrochloric Acid (DILUTED MURIATIC ACID).—Formula: Hydrochloric acid, 100; distilled water, 219.

Dose.—10–20 minims (0.6–1.2 Cc.) [15 minims (7 Cc.), U. S. P.].

Ăcidum Nitrohydrochlōricum — Ăcidi Nitrohydrochlōrici — Nitrohydrochloric Acid. (Described under *Nitric Acid.*)

Dose.—2–5 minims (0.12–0.3 Cc.), well diluted [3 minims (0.2 Cc.), U. S. P.].

Ăcidum Nitrohydrochlōricum Dilūtum—Ăcidi Nitrohydrochlōrici Dilūti—Diluted Nitrohydrochloric Acid. (Described under *Nitric Acid.*)

Dose, 5–20 minims (0.3–1.2 Cc.) [15 minims (1 Cc.), U. S. P.].

Ăcidum Phosphŏricum—Ăcidi Phosphŏrici—Phosphoric Acid. *U. S. P.*

Origin.—A liquid composed of not less than 85 per cent. by weight of absolute orthophosphoric acid ($H_3PO_4 = 97.8$) and not more than 15 per cent. of water.

Description and Properties.—A colorless liquid, without odor, but having a strongly acid taste. Specific gravity not below 1.707 at 25° C. (77° F.). Miscible in all proportions with water or alcohol. Phosphoric acid should be kept in glass-stoppered bottles.

Dose.—The diluted acid only is given internally.

Official Preparation.

Ăcidum Phosphŏricum Dilūtum—Ăcidi Phosphŏrici Dilūti—Diluted Phosphoric Acid.—Diluted phosphoric acid contains 10 per cent. by weight of absolute orthophosphoric acid.

Dose.—5–25 minims (0.3–1.5 Cc.) [15 minims (2 Cc.) U. S. P.].

Ăcidum Sulphūricum—Ăcidi Sulphūrici—Sulphuric Acid. *U. S. P.*

Origin.—A liquid composed of not less than 92.5 per cent. by weight of absolute sulphuric acid ($H_2SO_4 = 97.82$) and not more than 7.5 per cent. of water.

Description and Properties.—A colorless liquid of oily consistence, inodorous, and very caustic and corrosive. Specific gravity not below 1.826 at 25° C. (77° F.). Miscible in all proportions with water and alcohol, with evolution of so much heat that the mixing requires great caution. Sulphuric acid should be kept in glass-stoppered bottles.

Official Preparations.

Ăcidum Sulphūricum Aromăticum—Ăcidi Sulphūrici Aromătici—Aromatic Sulphuric Acid.—Formula: Sulphuric acid, 110; tincture of ginger, 50; oil of cinnamon, 1; alcohol to make 1000 parts.

Dose.—5–20 minims (0.3–1.2 Cc.) [15 minims (1 Cc.), U. S. P.].

Ăcidum Sulphūricum Dilūtum—Ăcidi Sulphūrici Dilūti—Diluted Sulphuric Acid.—Diluted sulphuric acid contains 10 per cent. by weight of absolute sulphuric acid.

Dose.—5–20 minims (0.3–1.2 Cc.) [30 minims (2 Cc.), U. S. P.].

Ăcidum Nītricum—Ăcidi Nītrici—Nitric Acid. *U. S. P.*

Origin.—A liquid composed of 68 per cent. by weight of absolute nitric acid ($HNO_3 = 62.89$) and 32 per cent. of water.

Description and Properties.—A colorless, fuming liquid, very caustic and corrosive, and having a peculiar, somewhat suffocating odor. Specific gravity about 1.403 at 25° C. (77° F.). Nitric acid should be kept in dark, amber-colored, glass-stoppered bottles.

Official Derivatives.

Ăcidum Nītricum Dilūtum—Ăcidi Nītrici Dilūti—Diluted Nitric Acid.—Diluted nitric acid contains 10 per cent. by weight of absolute nitric acid.

Dose.—5–20 minims (0.3–1.2 Cc.) [30 minims (2 Cc.), U. S. P.].

Ăcidum Nītrohydrochlŏricum — Ăcidi Nītrohydrochlŏrici — Nitrohydrochloric Acid.—Formula: Nitric acid, 180; hydrochloric acid, 820 parts.

Description and Properties.—A golden yellow, fuming, and very corrosive liquid, having a strong odor of chlorine. Completely volatilized by heat. It readily dissolves gold-leaf, and a drop of it added to potassium iodide T. S. liberates iodine.

Dose.—1–3 minims (0.06–0.18 Cc.) [3 minims (0.2 Cc.), U. S. P.].

Ăcidum Nitrohydrochlŏricum Dilūtum—Ăcidi Nitrohydrochlŏrici Dilūti—Diluted Nitrohydrochloric Acid.—Formula: Nitric acid, 40; hydrochloric acid, 182; distilled water, 780 parts.—*Dose*, 5–20 minims (0.3–1.2 Cc.) [15 minims (1 Cc.), U. S. P.].

Antagonists and Incompatibles.—Hydrochloric acid and its preparations are incompatible (forming explosive compounds) with oxidizable substances—phosphorus, sulphur and the sulphides, alcohols, ethers, carbohydrates, etc. All the mineral acids are incompatible with the alkalies and their carbonates, salts of lime, lead, and silver, and decompose glycosides.

Synergists.—The action of hydrochloric acid upon the digestive system is aided by the digestive ferments and the vegetable bitters.

Physiological Action.—The general action of mineral acids upon the various systems is herewith given in detail:

Externally and Locally.—Applied in a concentrated form to the skin or to any tissue of the body, acids abstract the water from the tissues and destroy the protoplasm, acting as escharotics. Weaker solutions *vesicate*, merely inflaming the parts to which they are applied, without destroying the tissue, while extremely diluted or weak solutions are irritant and *astringent.*

Internally.—Digestive System.—Diluted acids only should be administered internally. Save with reference to the poisonous effects of concentrated acids, therefore, the physiological action of diluted acids only will be here considered.

The salivary glands are stimulated, resulting in an increased flow of saliva, moistening the mouth and allaying thirst. The appetite and digestion are improved, and the secretions from the liver and the duodenal glands are increased. Long-continued use of the mineral acids impairs digestion by lessening the normal secretion of the gastric glands, while protracted use may produce salivation and a train of symptoms—anemia, loss of flesh, etc. Mineral acids tend to constipate.

Circulatory System.—Diluted acids in medicinal doses cause a rise in blood-pressure and increased action of the heart, probably due to their stimulating action on the vasomotor mechanism. Concentrated acids relax the muscular tissue of both the heart and blood-vessels. Mineral acids combine with the albumin or the alkaline bases of the blood, lessening the alkalinity of that fluid.

Nervous System.—Medicinal doses, so far as observed, produce no special action upon the nervous system.

Respiratory System.—No important action under medicinal doses has been observed.

Absorption and Elimination.—Mineral acids, above all hydrochloric acid, are readily absorbed. Diluted acids are converted into neutral salts in the intestines, and are absorbed as such. The excess of the acid which does not enter into combination in the stomach and intestines is rapidly absorbed into the blood, combining with its alkaline bases, and in this form is excreted, principally by the kidneys, as acid salts.

Temperature.—Medicinal doses have no influence upon temperature.

Untoward Action.—Mineral acids under too-prolonged administration impair the appetite and disturb digestion, occasioning toothache and gastric oppression, and at times salivation and diar-

rhea. They may also produce anemia, paleness of skin, and loss of flesh (Nothnagel and Rossbach). When taken for long periods and in comparatively large quantities they have a distinct degenerative action on the heart, the liver, and the kidneys. The prolonged use of nitric acid may produce erosion of the gums and tongue, with loosening of the teeth. Chromic acid and osmic acid act very energetically on the parenchyma of the kidneys.

Poisoning.—The mineral acids when taken in a concentrated form and in toxic doses act as corrosive poisons, causing intense burning in the stomach and intestines and active gastric inflammation. Violent vomiting occurs, the ejected matter containing blood, and, in the case of hydrochloric acid, a white cloud of ammonium chloride is discerned if the ejecta be placed near the vapor of ammonia.

The respiration is greatly depressed, and there is a strong, persistent acid taste in the mouth, the mucous membrane of which is discolored, while the tongue is swollen and inflamed. There is great thirst, and the pulse becomes rapid and tense. The temperature, at first elevated, soon falls below normal, profound prostration supervening, and death resulting either from shock or from secondary inflammation.

A *postmortem* examination shows the results of corrosive poisoning: ulceration or evidences of intense inflammation of the mucous membrane of the mouth, esophagus, stomach, and intestines. Occasionally the walls of the latter are perforated. Should death be delayed for some time, fatty degeneration of the kidneys and other internal organs is found.

Treatment of Poisoning.—This should be prompt. The cautious administration of alkalies is indicated to neutralize the acid, though the evolution of carbonic-acid gas resulting from some may rupture the stomach. The stomach should be washed out, and this treatment followed by demulcent drinks and oil, milk, and eggs. Opium may be necessary for the relief of pain, and brandy or whiskey subcutaneously in case of collape.

Therapeutics.—*Externally and Locally.*—HYDROCHLORIC ACID is employed as a caustic in *noma* and *putrid sore throat.* Mixed with two or three parts of honey, it is an efficient application to the throat in *diphtheria.* Andrews and Morris have recommended diluted hydrochloric acid for the *removal* of *sequestra,* and Chassaignac has utilized the acid in removing necrosed bone in *osteitis* and *caries.*

NITRIC ACID is a much more powerful caustic, and as such is used more extensively than any other mineral acid, because of its limited action and the ease with which it is controlled. It is an excellent caustic in cases of *cancer of the cervix, venereal warts, hospital gangrene, phagedenic ulceration, hemorrhoids,* and *prolapse of the rectum,* especially in the case of children. In cases also *of fungoid granulation* and *excessive hemorrhage from the uterus* it has been highly recommended. In certain *diseases of the throat,*

nose, and *ear* this acid has been used for the destruction of growths, as well as for its escharotic action in ulcerated conditions.

Dermatologists find nitric acid to be an efficient application for the removal and destruction of *epithelioma*, *moles*, *nevi*, *chloasma*, etc., caution being exercised in the latter case merely to produce an exfoliation of the skin, not sufficient destruction of tissue to result in a cicatrix.

Liveing recommends a very weak solution of nitric acid with tincture of opium in *pruritis*.

PHOSPHORIC ACID, in the strength of 50 grains (3.2 Gm.) to the ounce (30.0 Cc.) of distilled water, has been suggested by Grossich in the treatment of *scrofulous ulcers*, and an injection of this solution into *tuberculous glands* of the neck is highly recommended by the same authority.

SULPHURIC ACID is perhaps the most persistent, irritating, and destructive caustic known. Its affinity for water, and its consequent extensive action, render it, when used alone, unfit for caustic purposes. Mixed with powdered charcoal, however, it forms a paste which is an efficient caustic application to *chancres*, *cancers*, etc. Frazer considers the strong sulphuric acid the best caustic in the *bites of rabid animals*. Diluted solution, in the proportion of 6 parts of the strong acid to 4 parts of diluted alcohol, has been recommended for *epistaxis*.

The eschar formed by the three chief mineral acids is of diagnostic interest. Sulphuric acid, brown to black; nitric acid, yellow; hydrochloric acid, white to grayish-white.

Internally.—HYDROCHLORIC ACID, being a normal constituent of the stomach, is indicated in certain forms of *gastric dyspepsia*, particularly in the atonic variety. In these latter cases there is usually decomposition and fermentation of food, which condition is greatly relieved by the administration of pepsin or hydrochloric acid after meals, or the same with bitters before meals.

In *intestinal indigestion* hydrochloric acid is an admirable remedy, given one to two hours after meals.

The diluted hydrochloric acid is a useful remedy in the treatment of *typhoid*. It allays thirst, moistens the tongue, aids digestion and exerts an antiseptic influence in the bowels, thereby lessening the flatus.

In certain *affections of the skin* dependent upon deranged digestion, hydrochloric acid often proves a potent remedy.

NITRIC ACID has been used for the same purposes as hydrochloric acid, although for digestive disorders it is inferior to the latter drug.

In *intermittent* and *periodical fevers*, however, nitric acid is an efficient remedy. In *hepatic disorders* the diluted nitrohydrochloric acid deservedly holds a high place as a remedial agent, and the same remedy is frequently employed with success in *chronic syphilis*, but solely by reason of its improving the appetite.

In the conditions known as *oxaluria* and *lithemia* nitric and nitrohydrochloric acids serve an excellent purpose.

The *aphonia* of singers and public speakers is often relieved by the diluted nitric acid, certain cases of *bronchitis* being also benefited by the same remedy.

PHOSPHORIC ACID has acquired some reputation as a remedy in *anemia* and as a tonic in *wasting diseases* and *neurasthenia*. Its value, however, is based more upon hypothesis than upon the results of clinical observation.

Possibly phosphoric acid is superior to the other mineral acids only in its action in *diabetes*, in which disease it certainly possesses a remarkable influence in diminishing thirst and lessening the secretion of urine.

SULPHURIC ACID is inferior to nitric or nitrous acid in *serous diarrhea*. It is nevertheless an invaluable, as well as an old and tried, remedy in *cholera*.

This remedy also deserves favorable consideration in the treatment of *acute lead-poisoning*. Moreover, in *chronic lead-poisoning* water acidulated with sulphuric acid makes an efficient prophylactic, and the remedy has also been suggested as a preventive of *Asiatic cholera*.

Owing to its astringent and antiseptic properties this acid, particularly the aromatic sulphuric acid, proves a good remedy in certain cases of diarrhea. It is especially valuable in limiting the *sweating in phthisis*.

In *scurvy* and *purpura*, sulphuric acid has proved valuable, and it has been recommended as an internal remedy in *lichen*, *prurigo*, and many *itching diseases of the skin*.

Contraindications.—Acute inflammation of the stomach, rheumatism, gout, and where the urine is excessively acid and of high specific gravity.

Administration.—Only the diluted acids should be given internally, and even these should be further diluted, and taken, if possible, through a glass tube, to prevent injury to the enamel of the teeth. They are best given after meals, and should not be administered for too long a period; and the first indication of untoward action, such as griping, diarrhea, etc., is to be taken as a warning that the drug must be withdrawn.

ORGANIC ACIDS.

Ăcidum Lăcticum—Ăcidi Lăctici—Lactic Acid. *U. S. P.*

Origin.—An organic acid usually obtained by subjecting milk sugar or grape sugar to lactic fermentation. It is composed of 75 per cent. by weight of absolute lactic acid ($HC_3H_5O_3 = 89.79$) and 25 per cent. of water.

Description and Properties.—A colorless, syrupy liquid, odorless, of a purely acid taste, and absorbing moisture on exposure to damp air. Specific gravity about 1.206 at 25° C. (77° F.). Freely miscible with water, alcohol, or ether; insoluble in chloroform, benzin, or carbon disulphide.

Dose.—20–30 minims (1.2–1.8 Cc.), diluted and sweetened. [30 minims (2 Cc.), U. S. P.].

Official Preparation.

Sȳrupus Călcii Lactophosphătis—Sȳrupi Călcii Lactophosphătis—Syrup of Calcium Lactophosphate.—Formula: Precipitated calcium carbonate, 25; lactic acid, 60; phosphoric acid, 36; orange-flower water, 55: sugar, 725; water, q. s. ad 1000. *Dose*, 1–2 fluidrams (3.7–7.3 Cc.) [2 fluidrams (8 Cc.), U. S. P.].

Antagonists and Incompatibles.—Alkalies and the salts of the mineral acids are incompatible with lactic acid.

Synergists.—Pepsin, vegetable acids, hydrochloric acid, and sodium chloride.

Physiological Action.—*Externally and Locally.*—Lactic acid is a caustic to highly organized tissues, resembling the mineral acids in its local action. It can dissolve false membrane.

Internally.—Digestive System.—It is thought to be present in the stomach during the first forty-five minutes of stomachic digestion, but cannot be considered a normal constituent of the gastric juice.

Circulatory System.—Being absorbed from the stomach, it combines with bases in the blood, forming lactates which are rapidly converted into carbonates.

Nervous System.—Large doses are thought to depress the nervous system.

Absorption and Elimination.—It is absorbed from the stomach, undergoes a change in the blood, and is eliminated by the kidneys, although, according to Lehmann, when large doses have been taken it is found in the urine unchanged; and we have Benzelius and Scherer as authorities that lactic acid can be detected in the spleen and the muscular fluid. It has been found in the exudates in puerperal fever.

Untoward action, *poisoning*, and *treatment of poisoning* are similar to those of the mineral acids.

Therapeutics.—*Externally and Locally.*—It has been used locally for the same purposes as the mineral acids, but it is thought by many clinicians to be superior to the latter in *tuberculous ulceration.*

As a solvent of false membranes lactic acid is unquestionably superior to the mineral acids, being highly recommended for this purpose in diphtheria and croup by many authorities.

Internally.—Digestive System.—It is used in the digestive disorders, such as *atonic* and *irritative dyspepsia*, and in all those derangements of digestion which are benefited by hydrochloric acid. In *oxaluria*, *lithemia*, *chronic cystitis* with ammoniacal urine, *chronic dysentery*, and *dyspeptic* and *tuberculous diarrhea* it has proved an efficient remedy. It has been recommended as a prophylactic in *gout.*

Since this drug was suggested by Cantani as a remedy in *diabetes mellitus* it has been used with varying success. Balfour and Foster, as well as Cantani himself, have reported many cases which have greatly improved under the administration of lactic acid accompanied by an appropriate dietetic regimen.

Contraindications.—The same as for mineral acid.

Administration.—Lactic acid should be given well diluted.

Ăcidum Acēticum—Ăcidi Acētici—Acetic Acid. *U. S. P.*

Origin.—A liquid composed of 36 per cent. by weight of absolute acetic acid ($HC_2H_3O_2 = 59.86$) and 64 per cent. of water.

Description and Properties.—A clear, colorless liquid, having a strong, vinegar-like odor, a purely acid taste, and a strongly acid reaction. Miscible with water or alcohol in all proportions.

Dose.—The diluted acid only is given internally.

Official Preparations.

Ăcidum Acēticum Dilūtum—Ăcidi Acētici Dilūti—Diluted Acetic Acid (6 per cent.).—*Dose,* 1–2 fluidrams (3.7–7.4 Cc.) [30 minims (2 Cc.), U. S. P.].

Ăcidum Acēticum Glăciale—Ăcidi Acētici Glaciālis—Glacial Acetic Acid.—Used as a caustic.

Ăcidum Cĭtricum—Ăcidi Cĭtrici—Citric Acid. *U. S. P.*

Definition.—A tribasic organic acid, $C_3H_4(OH)(COOH)_3 + H_2O$, usually prepared from the juice of limes or lemons.

Description and Properties.—Colorless, translucent, right-rhombic prisms; odorless, having an agreeable, purely acid taste; efflorescent in warm air and deliquescent when exposed to moist air. Soluble in 0.54 part of water, in 1.55 parts of alcohol, in about 0.4 part of boiling water, and in 1.43 parts of boiling alcohol.

Dose.—5–20 grains (0.3–1.25 Gm.) [7½ grains (0.5 Gm.), U. S. P.].

Official Preparation.

Sўrupus Ăcidi Cĭtrici—Sўrupi Ăcidi Cĭtrici—Syrup of Citric Acid.—*Dose,* 2–8 fluidrams (7.4–30.00 Cc.) (0.1 per cent.).

Ăcidum Tartăricum—Ăcidi Tartărici—Tartaric Acid. *U. S. P.*

Definition.—A dibasic organic acid, $C_2H_2(OH)_2(COOH)_2$, usually prepared from argol.

Description and Properties.—Colorless, translucent, monoclinic prisms, or crystalline crusts, or a white powder; odorless, having a purely acid taste, and permanent in air. Soluble in about 0.71 part of water and in 1.67 parts of alcohol; also in about 0.5 part of boiling water, and in 0.2 part of boiling alcohol.

Dose.—10–30 grains (0.6–2.0 Gm.) [7½ grains (0.5 Gm.), U. S. P.].

Antagonists and Incompatibles.—Alkalies are chemically incompatible with the vegetable acids. With the alkaline, earthy, and metallic bases vegetable acids unite to form salts, the acetates of which are all soluble.

Synergists.—Alkalies, and, under certain circumstances, mineral acids and the digestive ferments.

Physiological Action.—*Externally and Locally.*—The vegetable acids have about the same action externally and locally as the diluted mineral acids, not caustic but irritant, acetic acid being the most powerful and citric acid the weakest.

Internally.—Digestive System.—Their action on the salivary and gastric glands is similar to that of the mineral acids. Their influence upon the stomach is not so marked as that of hydrochloric acid, though the secretions from the intestinal glands are more augmented by vegetable than by mineral acids. Too large or continued doses of the vegetable acids produce flatulence and abdominal pain, and may even occasion diarrhea or enteritis.

Circulatory System.—Large doses retard and weaken the pulse. The oxidizable organic acids increase the alkalinity of the blood and of the urine, thus differing from the mineral acids.

Absorption and Elimination.—As stated, vetetable acids unite with the alkalies to form salts, as such entering the circulation. They are eliminated chiefly by the kidneys, increasing the excretion of both water and solids. Elimination also takes place to a considerable extent by the intestinal canal.

Poisoning.—Their toxic effects vary widely. Some are non-toxic—citric; tartaric is slightly toxic in very large doses; oxalic is a severe poison, the symptoms of which differ in many respects from those of poisoning by the mineral acids. The most important symptoms are: Either gastro-intestinal irritation with profound collapse or, at times, there is simple collapse with weak heart, stupor, unconsciousness, and death, due to central paralysis. Poisoning by potassium oxalate adds the effects of potassium, and there is more profound cardiac collapse.

Treatment of Poisoning.—Mild alkalies control the action of the milder organic acids. In oxalic-acid poisoning—suicidal, or poisoning by potassium oxalate, accidentally eating of "sour grass," rhubarb, rumex, or sorrel oxalis in any form—use gastric lavage, followed by magnesia or chalk, well diluted. Cardiac and respiratory stimulants are necessary. Small doses of opium and strychnine and atropine may be of service. Glacial acetic acid is a powerful corrosive acid.

Therapeutics.—*Externally and Locally.*—All the vegetable acids here described are irritant, more or less antiseptic, and hemostatic, ACETIC ACID being the most powerful antiseptic of the three. Englemann regards acetic acid as superior to mercuric chloride as a disinfectant in *obstetrical practice*, employing a solution of from 3 to 5 per cent. for this purpose. A diluted solution is a valuable injection in *gonorrhea* of the female. Glacial acetic and trichloracetic acids are powerful caustics, and are much used to dissolve *horny growths*, *warts*, *corns*, etc.

The most important use of acetic acid is in the treatment of certain *parasitic skin diseases*, probably no remedy excelling it in cases of *ringworm* and *pityriasis*. Diluted acetic acid, or vinegar, is an efficient gargle in simple *sore throat* and the last stage of *anginæ* of *exanthemata*, as well as a valuable hemostatic, especially in *epistaxis*.

CITRIC ACID is but little used locally, although solutions have been employed with some success to relieve the itching and sting-

ing of "prickly heat" and *urticaria.* A sponge-bath of lemon and water is a grateful and efficient means of *reducing temperature* and checking *excessive sweating* in disease.

TARTARIC ACID has been used by Potter as an application to the throat in *diphtheria*, the effect being to convert the membrane into a gelatinous mass, which is more easily expelled.

Internally.—ACETIC ACID is little used internally. Citric acid, however, in the form of a lemonade, is a refreshing refrigerant drink in *fevers*, while a similar hot lemonade taken at bedtime is a valuable and agreeable means of aborting a "cold." Lemon- or lime-juice is useful in *scurvy*, being unquestionably the most efficient remedy for the disease.

It is well known by the laity that eating lemons increases the functional activity of the liver. Lemons and CITRIC ACID, therefore, are efficient remedies in relieving attacks of *biliousness* and *catarrhal jaundice*, and they even appear to counteract the effects of *malaria.* Lemon-juice is an old and esteemed remedy in *acute rheumatism.* Citric acid is an invaluable adjunct in rendering the urine bland in gonorrheal or other forms of cystitis.

Vegetable acids are used for the same disorders of the digestive tract as mineral acids, although not so efficient as the latter, especially hydrochloric acid. Much of the benefit derived from sour table-wines is due to the fruit-acids they contain.

Contraindications.—Ordinarily the same as for mineral acids. It is a matter of observation that nursing mothers may produce a troublesome diarrhea in the infant by partaking too freely of vinegar or acid fruits.

Administration.—A solution of citric acid may be made of about the acidity of lemon-juice by dissolving 570 grains (36.93 Gm.) in 1 pint (473.17 Cc.) of distilled water. Vegetable acids when taken internally should be mixed with, or dissolved in, water and diluted and sweetened, that they may be pleasant to the taste and acceptable to the stomach.

SODIUM SALTS.

Sōdium Chlōridi—Sōdii Chlōridi—Sodium Chloride. *U. S. P.*

Description and Properties.—Colorless, transparent, cubical crystals, or a white, crystalline powder, odorless, and having a purely saline taste. Permanent in dry air. Soluble in 2.8 parts of water at 25° C. (77° F.), and in 2.5 parts of boiling water; almost insoluble in alcohol.

It should contain, when dried, not less than 99 per cent. of pure sodium chloride.

Average Dose.—Emetic, 240 grains (16 Gm.).

Sodium chloride, NaCl, although rarely given by way of the stomach, save as an emetic, plays such an important rôle in intravenous injections for the relief of shock, and is, moreover, so important a constituent of the body fluids, that it deserves consideration. The

physical phenomena connected with its absorption and action are typical of a class of actions constantly going on in the physiological processes of the body and as such are properly treated in a work on Physiology.[1]

Therapeutics.—*Local Action.*—Weak salt solutions applied to the skin penetrate the superficial layers. These become swollen. Stronger solutions, by tending to draw water from the tissues, are irritants—particularly to mucous membranes. Both salt and water may be absorbed through mucous membranes; but neither are taken in to any great extent by the skin. On the mucous membrane of the mouth, weak (hypotonic solutions) cause a slight swelling of the epithelium, while strong solutions are irritant, withdrawing water, and often inducing nausea and vomiting. Digestion is not markedly affected by small doses—indeed, the effects on taste may be said to be helpful to good digestion.

Internally.—Salt in weak solution is not known to induce any marked physiological reactions when taken by the mouth. When injected intravenously in strong solutions in animals death has been known to occur by reason of its action on the nervous system possibly because of its disturbance of water pressure in the nerve cells. Death in these cases is usually preceded by symptoms of lassitude, increased reflex excitability, and convulsions. Circulation is not known to be affected, save in the late stages. Blood changes are usually present. They consist, as a rule, of agglutination of the red blood cells with formation of capillary thrombi. With isotonic solutions no such results occur.

Certain effects on the blood are usually present even when the salt solution is absorbed through the intestinal walls. Very weak solutions bring about a condition of hydremia of the blood, whereas a reverse condition may follow the use of comparatively strong solutions of salt 1–2 per cent. The various intricacies of the reactions of lymph flow and blood flow have little place here, although of vital importance as biological, if not pharmacological, data.

The action of isotonic salt solution given by the rectum is of particular moment, since this is the avenue by which it is most frequently introduced. In anemic subjects the solution is absorbed with great rapidity, and the volume of the blood, particularly following its diminution from hemorrhage, rapidly increases. The blood-vessels become fuller; the vascular tone rises, the heart action becomes stronger, and bleeding patients at times in a semicomatose condition frequently may be brought out of their lethargy.

Saline solution thus introduced has a very marked diuretic action, particularly if the element of heat be added. The increase in the flow of urine is due in large part to the increase in the amount of fluid in the vessels, resulting in an increase in tension in the capillaries. The chlorides, and the potassium and sodium of the urine, are eliminated in larger quantities than are the sulphates,

[1] See Schaefer, *Text-Book of Physiology.*

phosphates, or urates, but practically all of these are increased in amount.

Tissue metabolism is stimulated by the use of salt, although certain investigators have thought that there results from its use a slight diminution in proteid catabolism. The general action is, however, one of increased lymphatic activity.

So far as salt baths are concerned, the effects, while they may be very beneficial, are not resident in the salt, so far as its absorption into the body is concerned. Hygienic, dietetic, and psychotherapeutic practices are more to the point in the treatment of patients at spas and watering places than the salts contained in the bathing water. As an irritant to the skin salt action is beneficial. It tones and invigorates the skin and thus, reflexly, the patient in general.

Salt when taken by the mouth is often very useful. It exerts a mild stimulating action on the gastric mucosa, and in combination with sulphates and other acids and salts is an essential element in all of the mineral waters, which will be discussed later.

Taken by the rectum (enteroclysis) or by the skin (hypodermoclysis) isotonic salt solutions are invaluable in the treatment of collapse conditions due to hemorrhage, to cholera, to dysentery, and often to the toxemias of the infectious diseases, notably diphtheria, typhoid, and pneumonia. Clinical evidence is certain as to the value of isotonic salt in solution for surgical shock, particularly when administered hot—112°–118° F. As a diuretic in kidney affections hot saline enemata are invaluable.

Līquor Sōdii Hydrŏxidi—Liquōris Sōdii Hydrŏxidi—Solution of Sodium Hydroxide. *U. S. P.*

(Solution of Sodium Hydrate.)

Origin.—An aqueous solution containing about 5 per cent. of sodium hydrate, NAOH = 39.76.

Description and Properties.—A clear, colorless liquid, odorless, having a very acrid and caustic taste and a strongly alkaline reaction.

Dose.—5–20 minims (0.3–1.8 Cc.) [15 minims (1Cc.), U. S. P.].

Sōdii Acētas—Sōdii Acetātis—Sodium Acetate. *U. S. P.*

Origin.—It may be obtained by neutralizing acetic acid with sodium carbonate. The usual article, however, is manufactured on a large scale in the United States in the process of purifying acetic acid from wood vinegar.

Description and Properties.—Colorless, transparent, monoclinic prisms, or a granular, crystalline powder, odorless, and having a cooling, saline taste; efflorescent in warm, dry air. Soluble in 11 parts of water and in 23 parts of alcohol; also in 0.5 part of boiling water and in 2 parts of boiling alcohol. Sodium acetate should be kept in well-stoppered bottles.

Dose.—15–60 grains (1.0–4.0 Gm.) [15 grains (1 Gm.), U. S. P.].

Sōdii Bicarbōnas—Sōdii Bicarbonātis—Sodium Bicarbonate. *U. S. P.*

Origin.—Prepared by saturating a mixture of 2 parts of crystallized, and 3 parts of dried, sodium carbonate with carbon dioxide, generated by the action of hydrochloric acid upon marble. The damp salt formed is shaken with one-half its weight of distilled water, the undissolved portion being dried by exposure to the air.

Description and Properties.—A white, opaque powder, odorless, and having a cooling, mildly alkaline taste; permanent in dry, but slowly decomposed in moist, air. Soluble in 12 parts of water at 25° C. (77° F.); above that temperature the solution loses carbon dioxide, and at a boiling heat the salt is entirely converted into normal carbonate. Insoluble in alcohol and ether. The drug should be kept in well-closed vessels, in a cool place.

Dose.—10–30 grains (0.6–2.0 Gm. [15 grains (1 Gm.), U. S. P.].

Official Preparations.

Mistūra Rhēi et Sōdæ—Mistūræ Rhēi et Sōdæ—Mixture of Rhubarb and Soda.—*Dose*, ¼–2 fluidounces (7.4–59 Cc.) [1 fluidram (4 Cc.), U. S. P.].

Trochisci Sōdii Bicarbonātis—Trochiscos (acc.) Sōdii Bicarbonātis—Troches of Sodium Bicarbonate.—*Dose*, 1 to 6 troches.

Pŭlvis Effervĕscens Compŏsitus—Pŭlvis Effervescĕntis Compŏsiti—Compound Effervescent Powder (*Seidlitz Powder*).—Sodium bicarbonate, 31; potassium and sodium tartrate, 93; tartaric acid, 27.

Dose.—Set of 2 powders. To be dissolved in water separately and then combined and taken while effervescing.

Sōdii Carbōnas Monohydrātus—Sōdii Carbonātis Monohydrāti—Monohydrated Sodium Carbonate. *U. S. P.*

Origin.—Obtained from sodium sulphate and sodium chloride, but chiefly by a complicated process, known as *Leblanc's*, from sodium sulphate, which is mixed with chalk and coal, the mixture ignited, and the resultant mass exhausted with water and concentrated, the carbonate separating from the hot liquid being purified.

Description and Properties.—Soluble in 2.9 parts of water at 25° C. (77° F.), in 0.09 part at 38° C. (100.4 F.), in 1.8 parts of boiling water, and in 8 parts of glycerin; insoluble in alcohol and ether. The aqueous solution gives an alkaline reaction with litmus-paper, and effervesces strongly with acids. The drug should be kept in well-closed vessels.

Dose.—2–15 grains (0.0125–1.0 Gm.) [4 grains (0.25 Gm.), U. S. P.].

The sodii carbon as contained 10 molecules of water of crystallization or 63 per cent.; part of this was lost on exposure to air, so that the salt was of uncertain strength. The sodii carbonas exsiccatus contained about 26 per cent. of water, and probably corresponded to the formula $Na_2CO_3 + 2H_2O$. This salt was somewhat hygroscopic. The monohydrated salt does not effloresce at ordinary temperatures, nor does it absorb much moisture. It is, therefore, more uniform in composition than either of the others.

Sōdii Cĭtras—Sōdii Citrātis—Sodium Citrate. *U. S. P.*

Description and Properties.—A white, granular powder, odorless, $2Na_3C_6H_5O_7 + 11H_2O$. It slowly effloresces on exposure to dry air. Soluble in 1.1 parts of cold water and in 0.4 part of boiling water; slightly soluble in alcohol.

Dose.—Average dose: 15 grains (1 Gm.), U. S. P.

Sōdii Phŏsphas Exsiccātus—Sōdii Phosphātis Exsiccāti—Exsiccated Sodium Phosphate. *U. S. P.*

Description and Properties.—This is also called anhydrous sodium phosphate, Na_2HPO_4; it is obtained by driving off the water of crystallization of sodium phosphate (U. S. P.), which amounts to 60.3 per cent. of the latter's weight. In a given weight of the exsiccated salt there are two and a half times as much sodium phosphate as in the same weight of the crystallized salt. It is a white powder which absorbs moisture readily when exposed to the air and is gradually transformed into a

salt of the composition $Na_2HPO_4 + 7H_2O$, which contains about 47 per cent. of water; the latter salt is permanent.

Dose.—Average dose: 15 grains (1 Gm.), U. S. P.

Sōdii Phŏsphas Efferv ĕscens—Sōdii Phosphātis Effervescentis—Effervescent Sodium Phosphate. *U. S. P.*

Description and Properties.—Composed of the exsiccated sodium phosphate, sodium bicarbonate, and tartaric and citric acids. It contains sufficient sodium bicarbonate to neutralize the tartaric and citric acids when it is dissolved in water, and the carbonic acid gas liberated gives a pleasant acidulous and effervescent taste.

Dose.—Average dose: 120 grains (8 Gm.), U. S. P.

POTASSIUM COMPOUNDS.

Līquor Potăssii Hydrŏxidi—Liquōris Potăssii Hydrŏxidi—Solution of Potassium Hydroxide. *U. S. P.*

Origin.—An aqueous solution containing about 5 per cent. of potassium hydrate.

Description and Properties.—A clear, colorless liquid, odorless, having a very acrid and caustic taste and a strongly alkaline reaction. It should conform to the same reactian and tests as an aqueous solution of potassa. (See *Potassa.*)

Dose.—5–20 minims (0.3–1.2 Cc.), well diluted [15 minims (1 Cc.), U. S. P.].

Potăssii Ăcetas—Potăssii Acetātis—Potassium Acetate. *U. S. P.*

Origin.—Prepared by the action of acetic acid upon potassium carbonate.

Description and Properties.—A white powder or crystalline masses, of a satiny lustre, odorless, and having a warm, saline taste; very deliquescent on exposure to the air. Soluble in 0.36 part of water and in 1.9 parts of alcohol; with increasing temperature it becomes much more soluble in both liquids. Potassium acetate should be kept in well-stoppered bottles.

Dose.—15–60 grains (1.0–4.0 Gm.) [30 grains (2 Gm.), U. S. P.].

Potăssii Bicarbōnas—Potăssii Bicarbonātis—Potassium Bicarbonate. *U. S. P.*

Origin.—Prepared by the action of carbon dioxide upon a solution of the carbonate.

Description and Properties.—Colorless, transparent, monoclinic prisms, odorless, and having a saline and slightly alkaline taste. Permanent in the air, soluble in 3.2 parts of water at 15° C. (59° F.) and in 1.9 parts at 50° C. (122° F.). At a higher temperature the solution rapidly loses carbon dioxide, and, after boiling, contains only potassium carbonate. It is almost insoluble in alcohol. The drug should be kept in well-stoppered bottles.

Dose.—10–40 grains (0.6–2.5 Gm.) [30 grains (2 Gm.), U. S. P.].

Potăssii Bitărtras—Potăssii Bitartrātis—Potassium Bitartrate. *U. S. P.*

(Cream of Tartar.)

Origin.—Prepared by purifying and crystallizing argol or crude tartar, a residuum of grape-juice after fermentation.

Description and Properties.—Colorless or slightly opaque, rhombic crystals,

or a white, somewhat gritty powder, odorless, and having a pleasant, acidulous taste; permanent in the air. Soluble in about 200 parts of water and in about 16.7 parts of boiling water; very slightly soluble in alcohol.

Dose.—10 grains to ½ ounce (0.6–16.0 Gm.) [30 grains (2 Gm.), U. S. P.].

Official Preparation.

Pŭlvis Jalăpæ Compŏsitus—Pulvĕris Jalăpæ Compŏsiti—Compound Powder of Jalap.—*Dose*, 10–30 grains (0.6–2.0 Gm.) [30 grains (2 Gm.), U. S. P.]; used as a hydragogue cathartic.

Potăssii Carbōnas—Potăssii Carbonātis—Potassium Carbonate. *U. S. P.*

Origin.—Prepared from the ash obtained from the residue of the beet-sugar manufacture. It may also be obtained from wood-ashes.

Description and Properties.—A white, granular powder, odorless, and having a strongly alkaline taste; very deliquescent; soluble in 0.9 part of water at 25° C. (77° F.) and in about 0.65 part of boiling water; insoluble in alcohol. Its aqueous solution (1:20) has a strongly alkaline reaction upon litmus-paper, and effervesces with acids. Potassium carbonate should be kept in well-stoppered bottles.

Dose.—5–30 grains (0.3–2.01 Gm.) [10 grains (1 Gm.), U. S. P.].

Potăssii Cītras—Potăssii Citrātis—Potassium Citrate. *U. S. P.*

Origin.—Prepared by the action of citric acid upon a solution of potassium carbonate.

Description and Properties.—Transparent, prismatic crystals, or a white, granular powder, odorless, and having a cooling, saline taste; deliquescent on exposure to the air. Soluble in 0.5 part of water at 25° C. (77° F.), and very soluble in boiling water; feebly soluble in alcohol. Potassium citrate should be kept in well-stoppered bottles.

Dose.—15–60 grains (1.0–4.0 Gm.) [15 grains (1 Gm.), U. S. P.].

Official Preparations.

Potăssii Cītras Effervĕscens—Potăssii Citrātis Effervescĕntis—Effervescent Potassium Citrate.—Potassium citrate, 200; sodium carbonate, 477; tartaric acid, 252; citric acid, 162.

Dose.—7–45 grains (0.5–3.0 Gm.).

Līquor Potăssii Citrātis—Liquōris Potăssii Citrātis—Solution of Potassium Citrate.—An aqueous liquid containing not less than 8 per cent. of anhydrous potassium citrate. To be made freshly when wanted.

Dose.—½–1 ounce (15–30 Cc.) [4 drams (16 Cc.), U. S. P.].

PREPARATIONS OF CALCIUM.

Călcii Carbōnas Præcipitātus—Călcii Carbonātis Præcipitati—Precipitated Calcium Carbonate. *U. S. P.*

Origin.—Prepared by mixing aqueous solutions of calcium chloride and sodium carbonate, the resulting precipitate of calcium carbonate being purified.

Description and Properties.—A fine white powder, without odor or taste, permanent in the air. Nearly insoluble in water, its solubility being increased by the presence of ammonium salts, and especially by carbonic acid, and diminished by alkali hydrates. Insoluble in alcohol, but in diluted acetic, hydrochloric, or nitric acid completely soluble, with effervescence.

Dose.—15–30 grains (1.0–2.0 Gm.) [15 grains (1 Gm.), U. S. P.].

Crēta Præparāta—Crētæ Præparātæ—Prepared Chalk. *U. S. P.*

Origin.—Native calcium carbonate, freed from most impurities by elutriation.

Description and Properties.—A white, amorphous powder, often molded into conical drops, odorless and tasteless, permanent in the air. Almost insoluble in water; insoluble in alcohol; soluble in diluted acetic, hydrochloric, or nitric acid, with copious effervescence, but without leaving more than a trifling residue.

Dose.—5–60 grains (0.3–4.0 Gm.) [15 grains (1 Gm.), U. S. P.].

Official Preparations.

Hydrărgyrum cum Crēta—Hydrărgyri cum Crēta—Mercury with Chalk.—*Dose,* 2–10 grains (0.12–0.6 Gm.) [4 grains (0.25 Gm.), U. S. P.]. (Described under *Hydrargyrum.*)

Pŭlvis Crētæ Compŏsitus—Pulvĕris Crētæ Compŏsiti—Compound Chalk Powder.—*Dose,* 20–60 grains (1.3–4.0 Gm.) [30 grains (2 Gm.), U. S. P.].

Līquor Călcis—Liquōris Călcis—Solution of Calcium Hydroxide. *U. S. P.*

(SOLUTION OF CALCIUM HYDROXIDE; LIME WATER.)

Origin.—A saturated aqueous solution which should contain not less than 0.14 per cent. of pure calcium hydroxide.

Description and Properties.—A clear, colorless liquid, without odor, and having a saline and feebly caustic taste. It absorbs carbon dioxide from the air, so that a pellicle of calcium carbonate forms on the surface of the liquid. On being heated it becomes turbid through separation of calcium hydrate, which redissolves when the liquid is cooled. It gives a strong alkaline reaction with litmus-paper.

Dose.—½–4 ounces (15.0–118.3 Cc.) [4 fluidrams (16 Cc.), U. S. P.].

Official Preparations.

Linimĕntum Călcis—Linimĕnti Călcis—Lime Liniment (CARRON OIL).—Equal parts of lime-water and linseed oil. For external use.

Mistūra Crētæ—Mistūræ Crētæ—Chalk Mixture.—Compound chalk powder, cinnamon water, and water.

Dose, 1–4 fluidrams (4.0–15.0 Cc.) [4 drams (16 Cc.), U. S. P.].

Sȳrupus Călcis—Sȳrupi Călcis—Syrup of Lime.—*Dose,* ½–2 fluidrams (1.8–7.4 Cc.) [30 minims (2 Cc.), U. S. P.].

PREPARATIONS OF LITHIUM.

Līthii Carbōnas—Līthii Carbonātis—Lithium Carbonate. *U. S. P.*

Origin.—Lithium is found in many mineral waters, the carbonate being prepared from lepidolite.

Description and Properties.—A light, white powder, odorless, and having an alkaline taste; permanent in the air. Soluble in 75 parts of water and 140 parts of boiling water; much more soluble in water saturated with carbon dioxide; insoluble in alcohol, but soluble in diluted acids, with active effervescence.

Dose.—2–10 grains (0.12–0.6 Gm.) [7½ grains (0.5 Gm.), U. S. P.].

Lĭthii Cĭtras—Lĭthii Citrātis—Lithium Citrate. *U. S. P.*

Origin.—Prepared by adding lithium carbonate to a solution of citric acid.

Description and Properties.—A white powder, odorless, and having a cooling faintly alkaline taste; deliquescent on exposure to the air. Soluble in 2 parts of water and in 1.5 parts of boiling water; almost insoluble in alcohol and ether. Lithium citrate should be kept in well-stoppered bottles.

Dose.—2–10 grains (0.12–0.6 Gm.) [7½ grains (0.5 Gm.), U. S. P.].

Official Preparation.

Lĭthii Cĭtras Efferv̆escens—Lĭthii Citr̆atis Effervesc̆entis—Effervescent Lithium Citrate.—*Dose.*—1–2 drams (4.0–8.0 Gm.) [2 drams (8 Gm.), U. S. P.].

PREPARATIONS OF MAGNESIUM.

Magnēsii Ŏxidum—Magnēsii Ŏxidi—Magnesia. *U. S. P.*

(LIGHT MAGNESIA; CALCINED MAGNESIA.)

Origin.—Prepared by subjecting magnesium carbonate to a low red heat in a Cornish or Hessian crucible closed loosely by a lid.

Description and Properties.—A white, very light, and very fine powder, without odor, and having an earthy, but not a saline, taste. On exposure to the air it slowly absorbs moisture and carbon dioxide. Almost insoluble in water and insoluble in alcohol, but soluble in diluted acids. Magnesia should be kept in well-closed vessels.

Dose.—As an antacid, 10–15 grains (0.6–1.0 Gm.) [30 grains (2 Gm.), U. S. P.].

Magnēsii Ŏxidum Ponderōsum—Magnēsii Ŏxidi Ponderosi—Heavy Magnesia. *U. S. P.*

(HEAVY MAGNESIA.)

A white, dense, and very fine powder, which should conform to the reactions and tests for magnesia, from which it differs in not readily uniting with water to form a gelatinous hydrate.

Official Preparation.

Pŭlvis Rhēi Compŏsitum—Pulv̆eris Rhēi Compŏsiti—Compound Powder of Rhubarb.—Formula: Rhubarb, 25; magnesia, 65; ginger, 10 parts.

Dose.—As a laxative, 20–60 grains (1.3–4.0 Gm.) [30 grains (2 Gm.), U. S. P.].

Magnēsii Carbōnas—Magnēsii Carbonātis—Magnesium Carbonate. *U. S. P.*

Origin.—Prepared by evaporating to dryness the mixed solutions of magnesium sulphate and sodium carbonate, and purifying and drying the residue.

Description and Properties.—Light, white, friable masses, or a light, white powder, without odor, and having a slightly earthy taste; permanent in the air. Almost insoluble in water, to which, however, it imparts a slightly alkaline reaction; insoluble in alcohol, but soluble in diluted acids, with active effervescence.

Dose.—As an antacid, 5–20 grains (0.3–1.3 Gm.) [44 grains (3 Gm.), U. S. P.].

Official Preparation.

Lĭquor Magnēsii Citrātis—Liquōris Magnēsii Citrātis—Solution of Magnesium Citrate.—A liquid of magnesium carbonate, citric acid, and potassium bicarbonate, widely used as a pleasant laxative.

Dose.—2–12 ounces (60–360 Cc.).

Magnēsii Sŭlphas—Magnēsii Sulphātis—Magnesium Sulphate.

See *Cathartics.*

PREPARATIONS OF AMMONIUM.

Ammōnii Carbōnas—Ammōnii Carbonātis—Ammonium Carbonate. *U. S. P.*

Origin.—Prepared by a complicated process by heating in an iron or earthen retort a mixture of sal ammoniac and chalk.

Description and Properties.—White, hard, translucent, striated masses having a strongly ammoniacal odor without empyreuma, and a sharp, saline taste. On exposure to the air the salt loses both ammonia and carbonic acid, becoming opaque, and is finally converted into friable porous lumps or a white powder. Slowly but completely soluble in about 5 parts of water at 15° C. (59° F.), and decomposed by hot water, with the evolution of carbonic acid and ammonia. By prolonged boiling with water the salt is completely dissipated. The aqueous solution possesses a strongly alkaline reaction and effervesces with acids.

Dose.—3–10 grains (0.18–0.6 Gm.).

Official Preparation.

Spĭritus Ammōniæ Aromăticus—Spĭritus Ammōniæ Aromătici—Aromatic Spirit of Ammonia.—Composition: Ammonium carbonate, ammonia water, aromatic oils, alcohol, and water.

Description and Properties.—A nearly colorless liquid when freshly prepared, but gradually acquiring a somewhat darker tint. It has a pungent, ammoniacal odor and taste.

Dose.—½–1 fluidram (1.8–3.7 Cc.) [30 minims (2 Cc.), U. S. P.].

Antagonists and Incompatibles.—The alkalies and their carbonates are incompatible with acids and with metallic salts. The ammonium carbonate is incompatible with the acidulous salts and with lime water.

Synergists.—Agents promoting waste, such as vegetable acids, mercury, iodine, etc., increase the therapeutic activity of the alkalies.

Physiological Action.—The alkalies mentioned in this group may be divided into *direct antacids*, or those which neutralize or lessen the acidity of the stomach, and *indirect antacids*, or those which, being oxidized in the blood, are excreted as carbonates, diminishing the acidity of the urine and increasing the alkalinity of the blood, although not influencing the acidity in the stomach.

The *direct antacids* are lime water, prepared chalk, and magnesia.

The *indirect antacids* are potassium acetate, bitartrate, citrate, and tartrate, sodium acetate, and lithium citrate.

The following alkalies are both *direct* and *indirect antacids:* solution of potassa, solution of soda, carbonates and bicarbonates of potassium, sodium, lithium, magnesium, and ammonium.

The physiological action of the various alkalies will now be considered in detail.

Externally and Locally.—The hydrates of potassium and sodium are caustic and rubefacient. The solutions of soda and potassa, when applied undiluted, irritate the surface of the skin and soften and dissolve the epidermis and horny tissues, uniting with the albumin of the various structures to form a soluble alkali-albuminate. The carbonates and bicarbonates exert a similar, though much weaker, action, while the acetates, bitartrates, citrates, and tartrates have no local influence.

The ammonium salts do not affect the epidermis in the manner of those previously mentioned, penetrating without dissolving it, irritating the underlying structures, and inducing an effusion of lymph, thus acting as vesicants. Should a strong solution of ammonia be applied to the skin and evaporation be prevented, suppuration and sloughing may ensue.

Internally.—Digestive System.—Potassium salts in small doses promote the secretion of gastric juice. Large doses neutralize free acid in the stomach, and, by rendering the chyme neutral or alkaline, interefere with the secretion from the pancreas, liver, and intestines, thereby deranging digestion.

The statement that alkaline carbonates given before a meal increase the secretion of gastric juice seems to rest more on clinical interpretation than on experimental evidence, for lower animals, at least. The so-called "law of contraries," taught for so many years, has little foundation in experimental work. The therapeutic results sometimes obtained must be explained on other grounds.

Circulatory System.—The alkaline salts of potassium, by lessening the acidity of the gastric juice and entering the circulation, increase the alkalinity of the blood. The *bicarbonates*, however, taken in large doses upon an *empty* stomach, enter the circulation unchanged, where, by decomposing the neutral phosphate of sodium present, they form the acid phosphate of sodium, reducing the alkalinity of the blood and increasing the acidity of the urine.

The acetates, citrates, and bitartrates enter the blood unchanged. The acid radical being destroyed, and the base combining with the carbon dioxide formed, the salts are converted into the alkaline carbonates, increasing the alkalinity of the blood and urine.

Should the caustic alkalies be injected directly into the blood, death quickly ensues from coagulation of that fluid, arising from excessive formation of alkali-albuminate. Under very large or poisonous doses the heart-muscle is weakened, decreasing the force of its contractions, arrest taking place in diastole. Even medicinal doses, if long continued, may occasion cardiac depression, diminishing the force of the circulation. Small doses may increase blood-pressure, though the pulse-rate be diminished. Minute amounts of

potassium salts applied to muscle diminish or paralyze its contractile power.

Nervous System.—When potassium salts are administered in medicinical doses and for a reasonable length of time, no important action upon the nervous system is produced; but if excessive doses be taken, the nerve-centers and motor nerves are paralyzed, after a period of temporary excitement. Owing, however, to the fact that potassium is a protoplasmic poison, affecting alike the muscles and nerve-tissues, its salts should not be given in full doses for too long a period without counteracting their depressing influence by the use of muscle and nerve-tonics.

Respiratory System.—The only action of importance upon the respiratory system is the increased amount and diminished viscidity of the secretion from the bronchial tubes.

Absorption and Elimination.—The potassium salts possess very high diffusive power. They are easily and quickly absorbed and rapidly excreted, the salts with vegetable acids being eliminated as alkaline carbonates, rendering the urine alkaline. Salts of potassium are chiefly eliminated by the kidneys, though the process takes place to some extent through the bronchial mucous membrane and other secretions. They are active diuretics, increasing the amount of water and, by stimulating the renal epithelium, augmenting the excretion of solids. The uric acid is greatly diminished, being converted into urea, and as such eliminated, showing that the alkalies increase oxidation and promote catabolism.

Temperature.—Medicinal doses have no effect upon temperature.

Untoward Action.—Under prolonged dosage the digestion becomes impaired. There is present paralysis of the muscular fibers of the intestines, accompanied by diarrhea or constipation and tympanities. There may be also present emaciation, muscular weakness, nervous prostration, and anemia.

Poisoning.—The caustic preparations of sodium and potassium produce the symptoms of the corrosive poisons, resembling the poisonous action of the mineral acids to be described. Death is occasionally preceded by convulsions, the heart's action being arrested before respiratory failure. The carbonates and bicarbonates and the salts of vegetable acids are not considered poisonous, nor do they produce the corrosive effects of caustic potash or its solution.

Treatment of Poisoning.—Vegetable acids are chemically incompatible, and should be given freely, together with oils and demulcent drinks as protectives, and opium, if necessary, to relieve pain. Cardiac stimulants—digitalis, brandy, caffeine, etc.—may be required to sustain the heart, to be given hypodermically.

The Comparative Action of the Alkalies.—SODIUM SALTS in their action are analogous to potassium, although less irritating to the gastro-intestinal tract. They are also less depressing to the circulatory, muscular, and nervous systems.

LITHIUM SALTS closely resemble in their effects those of potassium, their action upon the nerves and muscles, however, being

less powerful. The contractile force of muscle is invariably diminished by lithium and increased by potassium. They are useless as lithium in gout. The large amount of water with which they are usually given is the most potent factor in lithium "gout" cures.

CALCIUM SALTS are more sedative and astringent in their action upon the gastro-intestinal tract than the other alkalies, and are direct antacids. They tend to produce constipation. The nervous and muscular systems are less affected by these salts than by the remaining alkalies, the contractile muscular force, however, being increased by calcium. They are less readily absorbed and excreted than the foregoing alkalies, and less active in increasing the alkalinity of the urine. They are useful heart stimulants.

MAGNESIUM SALTS.—Magnesia and the magnesium carbonates are direct antacids and sedatives to the stomach, acting upon the intestinal canal as saline cathartics. In their influence upon the circulatory system they are feebler than, but similar to, the potassium salts, slightly increasing the alkalinity of the blood. They are not so readily absorbed, nor so rapidly excreted, as the salts of potassium and sodium, while increasing the amount of water and solids excreted.

AMMONIUM SALTS.—These preparations are used rather as cardiac stimulants, their physiological action being more extensively considered under that group. As antacids their action may be briefly compared with that of the other alkalies. Their effect upon the gastric juice and its secretion is similar to that of the carbonates and bicarbonates already mentioned. They dilate the blood-vessels of the stomach, augmenting the blood-supply and producing a sensation of warmth in the epigastrium. Lethal doses act as emetics. They increase the glycogenic function of the liver and stimulate the circulatory system, elevating the pulse-rate and raising arterial tension. In medicinal doses they stimulate the spinal cord, motor nerves, and muscles, while toxic doses paralyze these structures. They prevent the coagulation of the blood and lessen the oxygen-carrying power of the red corpuscles. By them also the respirations are increased in frequency.

The salts of ammonium are quickly absorbed and undergo oxidation in the body, augmenting the amount of uric acid and urea in the urine, thereby increasing its acidity to some extent.

As regards the poisonous activity of the alkalies mentioned, ammonium ranks, next to potassium, the most toxic of all.

Therapeutics.—*Externally and Locally.*—Norton has recommended LIQUOR POTASSÆ in *ingrowing toenail*, the solution being applied to the nail, which is soon rendered so soft that it can be easily scraped without causing pain. The same remedy is used in many *diseases of the skin* to allay itching and soften the horny epithelium. It is also employed extensively in *diseases of the ear* and *throat*, and in the proportion of 1 part to 10 parts of water it is very effective in softening *impacted cerumen.*

The POTASSIUM CARBONATE in solution is frequently used in various

pruriginous diseases of the skin, being a highly efficient antipruritic.

The detergent and sialagogue properties of POTASSIUM CITRATE and TARTRATE are rendered serviceable in certain *diseases of the mouth.*

SODIUM BICARBONATE is a deservedly popular dressing for *burns*, and *pain and swelling of the joints* in *acute articular rheumatism* are sometimes greatly relieved by enveloping the articulations in a hot solution rendered alkaline with this salt. In *diseases of the ear* it is used for the same purposes as the potassium preparations above mentioned. It is one of the ingredients of "Dobell's Solution," which is an effective antiseptic wash in *nasal catarrh*, and the solution of sodium bicarbonate has been suggested as a valuable remedy in *thrush* or *aphthæ.*

SODIUM CARBONATE may be used for the same purposes as the bicarbonate, though probably inferior to it in all cases save *infantile eczema capitis*, in which condition it is a most valuable remedy for softening the eczematous crusts.

PREPARED CHALK is an ingredient of many ointments used in the treatment of *erysipelas* and *subacute eczema.* LIME WATER, mixed with equal parts of linseed or olive oil, is highly prized as a dressing for *burns*, and the efficiency of the "black" and "yellow" washes in the treatment of veneral sores is too well known to require further testimony in their favor. These calcium preparations also make excellent applications in *acute eczema.* Lime water may sometimes be used with advantage in *leukorrhea* and *vaginitis.*

MAGNESIUM CARBONATE makes an efficient dusting powder in *dermatitis* and *irritable conditions of the skin.* AMMONIUM CARBONATE mixed with lanolin readily dissolves the epidermic scales of *psoriasis*, and the AROMATIC SPIRIT OF AMMONIA is a grateful application to the scalp in *pityriasis.*

Internally.—Digestive System.—The carbonates and bicarbonates, when given before meals, serve to increase the flow of gastric juice. They act as sedatives to the stomach, particularly in *painful conditions* arising from a *deficient secretion of gastric juice.* As antacids, when given after meals, they are very useful in counteracting *excessive acidity of the stomach.* The acidity due to the formation of fatty acids, the result of defective digestion, is not relieved by the administration of these salts after meals, but if taken before meals they are valuable in correcting the deficiency of gastric secretion, to which the disordered digestion is due. In *atonic dyspepsia* these preparations administered with vegetable bitters serve a useful purpose.

The bicarbonates and the salts of the vegetable acids are of some value in *gout*, possibly from changes in the composition of the blood, possibly by reason of the copious diuresis set up by the water and salt action. They are also of benefit occasionally in the treatment of *acute rheumatism.* Butler is of the opinion that in the treatment of acute rheumatic arthritis alkalies are far superior to any other drugs, salicylic acid not excepted.

While it is admitted that the treatment of acute rheumatism by alkalies alone will not shorten the course of the disease so readily as the employment of salicylates, he believes there is certainly less danger of heart-complications, the period of convalescence is reduced, and the tendency to relapse lessened by the use of alkaline remedies.

The acetates, bitartrates, and citrates are efficient diuretics, cathartics, and diaphoretics, the first-named salts being superior diuretics, the POTASSIUM BITARTRATE a reliable cathartic, and the citrates active diaphoretics.

In *chronic Bright's disease* the acetates and citrates are frequently indicated for their diuretic action, while POTASSIUM BITARTRATE is one of the most effective cathartics and diuretics in *acute nephritis* and *cardiac dropsy*.

LIME WATER is a useful remedy for *vomiting*—whether due to irritability, gastic ulcer, or cancer—and is also valuable in checking this symptom in *pulmonary tuberculosis*. It is an important adjunct to milk, in preventing the formation of curds and relieving *infantile vomiting*.

In the *acute mycotic diarrhea* of children, characterized by acid gastro-intestinal fermentation, the lime water is extremely useful. The symptoms also of *chronic diarrhea* and *dysentery* are often mitigated by this simple remedy.

LIME WATER is without doubt a very efficient remedy in *diabetes insipidus*, and may also exert a favorable influence in *chronic bronchitis* by checking and otherwise modifying the mucous secretion. It should be remembered that this preparation is a valuable antidote in *arsenical poisoning*. The syrup of lime is a very inferior remedy, the sugar which it contains neutralizing the beneficial action which the lime alone might exert.

PREPARED CHALK, OR CHALK MIXTURE, is useful in relieving the *premonitory diarrhea of cholera*, and *simple diarrheas of children*, with greenish acid stools and flatulent distention of the abdomen, are greatly benefited by this preparation. It is very necessary, however, that the chalk mixture be freshly prepared, the cinnamon water it contains being liable with age to fungoid contamination, and the propagation of micro-organisms, which might seriously aggravate the condition for which the remedy is given, occasioning vomiting etc. This old standby is being superseded, however, in later-day pediatrics by the use of mild salines and intestinal antiseptics. Chalk mixture is still useful, however, in diarrheas not due to bacterial causes.

MAGNESIA is an invaluble antacid in gastric disorders, and especially in *aphthæ* attending infantile diarrhea.

The AMMONIUM PREPARATIONS are useful antacids, being particularly efficacious in the *dyspepsia* of *drunkards* to allay nausea and vomiting, render the mucus less viscid, and act as stimulants to the circulation. Their excitant qualities, together with their property of modifying the mucous secretion, render them also of value in

appropriate cases of *subacute* and *chronic bronchitis*. In cardiac therapy the ammonium compounds are valuable as quick diffusible stimulants.

In conclusion, it may be well to mention the values of alkalies in *aiding the digestion of fats*, and as efficient remedies in the dyspepsia and indigestion from which obese, gouty, and rheumatic subjects frequently suffer.

The virtue and uses of mineral waters will be fully discussed in the group devoted to the subject. The use of many of the alkaline salines is further discussed under the heading *Cathartics*.

Administration.—The alkalies should invariably be administered largely diluted, thus favoring absorption and preventing their irritant action upon the gastro-intestinal mucous membrane. The time of administration—whether before or after meals—will depend entirely upon the effect desired, a thorough knowledge of their action as above given being necessary to an intelligent and proper use of the various preparations.

NITRATES.

Potăssii Nītras—Potăssii Nitrātis—Potassium Nitrate. *U. S. P.*

(NITRE; SALTPETRE.)

Origin.—Purified from native saltpetre.

Description and Properties.—Colorless, six-sided, rhombic prisms, or a crystalline powder; odorless, and having a cooling, saline, and pungent taste. Permanent in the air. Soluble in 3.6 parts of water, very sparingly soluble in alcohol.

Dose.—5–30 grains (0.3–2.0 Gm.) [7½ grains (0.5 Gm). U. S. P.].

Antagonists and Incompatibles.—Cardiac and diffusible stimulants antagonize the action of potassium nitrate upon the heart. Mineral acids and metallic salts are incompatible.

Synergists.—The cardiac depressants, diuretics, and agents increasing waste.

The action of the nitrates is, in the main, like the salts. There is thought to be a distinct nitrate ion action.

Physiological Action.—*Externally and Locally.*—The taste is cool and salty and the nitrates increase the flow of saliva.

Internally.—*Digestive System.*—Large doses occasion nausea and vomiting; poisonous doses produce violent gastro-intestinal inflammation and diarrhea, blood sometimes being vomited and passed with the stools.

Circulatory System.—Small doses have no marked influence on the circulatory system; full doses act as a cardiac depressant, slowing and weakening the pulse; poisonous doses produce great weakness, syncope, and death from cardiac failure. These results are possibly due to the action of the potassium ion.

Nervous System.—No special action is noticeable, although poisonous doses produce tremulousness, insensibility, and convulsions.

Respiratory System.—Large doses retard respiration.

Absorption and Elimination.—Potassium nitrate passes rapidly into the blood unchanged, and is eliminated by the kidneys unchanged. Small doses are actively diuretic, stimulating the renal cells. Large amounts, from too free stimulation, are apt to irritate and inflame the kidneys, even so far as to produce hematuria. The drug is also eliminated to some extent by the skin, being therefore a mild diaphoretic.

Temperature.—Unaffected by medicinal amounts, but lowered by poisonous doses.

Poisoning.—There is violent gastro-intestinal inflammation, with vomiting and purging, blood being present in the ejecta and feces. Other symptoms are—subnormal temperature, coldness of the extremities, a weak and thready pulse, slow and shallow respiration, tremulousness and great muscular weakness, dimness of vision or total blindness, deafness, insensibility, and possibly convulsions. The urine is diminished or supressed.

Should the patient recover from an immoderate dose of the drug, he suffers for some time from dysuria, irritability of the stomach, colic, muscular weakness, and a sensation of chilliness in the back and limbs.

Treatment of Poisoning.—There is no special antidote for nitre; cases of poisoning, therefore, are to be treated symptomatically, measures for relief including evacuation of the stomach, demulcents, opiates for pain, and cardiac and respiratory stimulants.

Therapeutics.—*Externally and Locally.*—Solutions of this drug have been found serviceable as applications to *bruises* and *abrasions.* The last stage of *pharyngitis* is greatly relieved by a gargle of a SOLUTION OF POTASSIUM NITRATE, in the proportion of 1 dram (4.0 Gm.) to 1 pint (473 Cc.) of water.

It is claimed that a paste of POWDERED NITRE and water applied to the face night and morning is an effective method of removing *freckles.* Suffice it to say it is not a panacea.

The difficulty of breathing in cases of *spasmodic asthma* may be at times relieved by the inhalation of the fumes of burning NITRE-PAPER.

Internally.—The drug was formerly much used in *acute articular rheumatism* and as a refrigerant and sedative in *inflammations, pneumonia,* and various *fevers.* It is employed to a considerable extent as a diuretic and diaphoretic, although greatly inferior to the acetates and citrates.

Administration.—It should be given in solution, though the powder is sometimes used in combination with calomel, tartar emetic, or Dover's powder.

The potassium-nitrate paper, as has been stated, should be burned and the fumes arising therefrom inhaled.

Sōdii Nītras—Sōdii Nitrātis—Sodium Nitrate. *U. S. P.*

Origin.—It is found in great quantities imbedded in clay and sand in certain districts of Chili and Peru.

Description and Properties.—Colorless, transparent, rhombohedral crystals, odorless, having a cooling, saline, and slightly bitter taste; deliquescent in moist air. Soluble in 1.3 parts of water and in about 100 parts of alcohol. Sodium nitrate should be kept in well-stoppered bottles.

Dose.—½–1 ounce (15.5–31.0 Gm.) [15 grains (1 Gm.), U. S. P.].

Physiological Action.—The action of the salt resembles closely that of potassium nitrate, though it is much feebler than the latter drug, particularly being less depressing to the heart muscle and in possessing greater purgative properties.

Therapeutics.—*Externally and Locally.*—A solution of the salt possesses some power as a solvent of false membranes, and has been used in the form of a spray to diminish *fibrinous exudations* in the pharynx and larynx.

Internally.—It may be employed for the same purpose as the potassium nitrate and has been advantageously adopted as a laxative in *diarrhea* and *dysentery.*

Administration.—Sodium nitrate is best given dissolved in a large quantity of water.

MINERAL WATERS.

The line of demarcation between mineral and ordinary waters cannot be definitely drawn. Although in the former there is usually present an increase of mineral constituents or of temperature, some drinking waters contain more mineral ingredients than others, while many very pure waters, both cold and warm, have been regarded for ages as mineral springs.

Although especially abundant in volcanic regions, mineral springs are by no means confined to them. They have been found on alpine heights—even at the snow-line in the Himalayas—and they rise from the bottom of the sea, as at Baiæ and Ischia.

The foreign ingredients of mineral waters, as shown by analysis, are very numerous, some of them occurring in exceedingly minute, others in large, quantities. Among them are soda, magnesium, calcium, potash, alumina, iron, boron, iodine, bromine, arsenic, lithium, cesium, rubidium, fluorine, barium, copper, zinc, manganese, strontium, silica, phosphorus, besides extractive substances and various organic deposits known under various names. The constituent gases include carbonic and hydrosulphuric acids, nitrogen, oxygen, hydrogen, and ammonia. Of all these, by far the most important from a therapeutic point of view are sodium, magnesium, iron, carbonic acid, sulphur, and perhaps hydrosulphuric acid.

These combinations are very numerous, some waters containing from 10 to 20 per cent. of them; yet there are always certain predominating constituents which mark the character of the spring, while many substances, such as cesium, rubidium, or fluorine, occur in mere traces and must be regarded as unimportant.

Mineral waters may be considered, therefore, as weaker or stronger solutions of salts and gases of higher or lower temperature, although the quantity of saline ingredients commonly bears but a very small proportion of that of the fluids containing them. For purposes of therapy they are used either externally in the form of baths or internally as beverages. With regard to the former use—or, to speak technically, balneotherapy—the scope of the present work precludes treatment *in extenso.* Enough to say that in certain conditions the system is uudoubtedly benefited by resort to baths of various characters, especially when accompanied by the accessory aid of well-considered diet and regimen.

The literature connected with the subject of potable waters is voluminous, yet the deductions drawn by various observers touching their efficacy and in relation to the comparative value of natural springs are too frequently colored by individual bias, or based upon too hasty analysis to furnish infallible data or warrant the definite statement possible in ordinary therapeutics. That certain waters charged with foreign ingredients when ingested react upon the body favorably in the case of certain disorders it were futile to deny. Yet even here there are subsidiary considerations not to be ignored; and it is an open question how far the patient may be relieved by the potency of the remedy *per se*, or whether the collateral aids of environment, climate, altitude, temperature, etc., may not have an important bearing upon beneficial results.

It has been well observed that in the case of water taken *in situ* the curative atmosphere of the surroundings, the favorable season of the year, the reflex influence of social amenities, and freedom from customary cares, aided by studied regimen under constant medical supervision, play no unimportant part in the alleviation of positive or imaginary disorders. The maxim, "Amuse the patient and let nature work the cure," seems not wholly inapplicable to many fashionable resorts where a constant round of gayety acts as a practical, though imperceptible, tonic or stimulant upon subjects of certain nervous susceptibilities. These considerations are no less forcible in the case of American "watering-places" than in those of the more famous resorts of Europe.

Various attempts have been made to arrange mineral waters according to their therapeutic action, their external and internal effects physiologically, and, most frequently, according to their chemical composition. Yet their influence is so dependent upon idiosyncrasy and their constituents so varied that it is well-nigh impossible to select a definite system free from objections, although a scientific classification, uniformly adopted, would undoubtedly promote their rational employment. Many sulphur waters are

practically earthy or saline ones, yet the presence of minute quantities of hydrosulphuric acid, an ingredient so palpable as always to attract attention, has determined a classification obviously at variance with natural fact. The general rule has been to class waters under the head of their predominating elements, the desideratum being comparative simplicity untrammelled by theoretical considerations.

ALKALINE.—These waters owe their chief therapeutic value to the alkaline salts they contain. They are rich in alkaline carbonates, especially the sodium carbonate. Other substances are included among their ingredients, many of them strongly charged with carbonic-acid gas, which may possibly contribute to their physiological activity.

SALINE.—These either contain (1) chloride of sodium as the principal ingredient, or (2) are largely impregnated with the sulphates of sodium and magnesium. Several other ingredients enter into their composition, yet their efficacy chiefly depends upon their predominating elements; the second class includes the bitter or purgative waters highly prized both in this country and abroad.

SULPHURETTED.—The sulphuretted hydrogen present in these waters lends to them their chief therapeutic value. They contain also various sulphides—of potassium, sodium, calcium, and magnesium—together with earthy and other sulphates, which doubtless contribute in a measure to their potency as physiological agents, although their action upon the system is still a matter of conjecture.

CHALYBEATE.—Many mineral springs contain iron, yet in amounts so insignificant as to be of little value to therapy. There are, however, chalybeate waters highly charged with iron salts in the form of the carbonate or sulphate which have acquired a reputation for efficacy in the treatment of certain diseases.

ACIDULOUS.—The valuable property of these springs lies in the superabundance of carbonic-acid gas they contain, to which the solid constituents are subordinate, the carbon dioxide being the important therapeutic ingredient.

CALCAREOUS.—Calcium, in the form of the carbonate, is the valuable constituent of calcareous waters. Besides this substance they contain magnesium carbonate in varying quantities. Their utility as mineral waters has been questioned, many authorities refusing them recognition as therapeutic agents.

The following enumeration of native springs is from the admirable list compiled by Dr. A. N. Bell:

Alkaline:

Adams, California.
Albury, Vermont.
Alma, Michigan.
Alum, Virginia.
Berkshire, Vermont.
Borax, California.
Blount, Alabama.
Cañon City, Colorado.
Carlisle, Colorado.
Congress, California.

Elgin, Vermont.
Fry's Soda, California.
Greencastle, Indiana.
Highgate, Vermont.
Highland, California.
Kittrell's, North Carolina.
Lower Soda, California.
Madison, Georgia.
Manitou, Colorado.
Manley, North Carolina.
Middletown, Vermont.
Milford, New Hampshire.
Montvale, Tennessee.
Napa Soda, California.
Newbury, Vermont.
Owasso, Michigan.
Perry, Illinois.
Ravenden, Arkansas.
Rocky Mountain, Colorado.
Rowland's, Georgia.
Schooley's Mountain, New Jersey.
Schuyler County, Illinois.
South Park, Colorado.
Sparta, Wisconsin.
Versailles, Indiana.

Purgative Saline:

Alma, Michigan.
Blue Lick, Kentucky.
Crab Orchard, Kentucky.
Elgin, Vermont.
Esculapian, Kentucky.
Harrodsburg, Kentucky.
Midland, Michigan.
Pagosa, Colorado.

Saline:

Fruit-Port Well, Michigan.
Grand Haven, Michigan.
Louisville Artesian, Kentucky.
Michigan Congress, Michigan.
Mt. Clemens, Michigan.
Ocean, Alabama.
St. Louis, Missouri.
Salt, Virginia.
Spring Lake Well, Michigan.

Sulphurous:

Alpena, Michigan.
Balston, New York.
Bladon, Florida.
Blue Lick, Kentucky.
Carlisle, Pennsylvania.
De Soto, Louisiana.
Sheldon, Vermont.
Summit, Maine.

Thermal Springs:

Agua Caliente, New Mexico.
Arrow-Head, California.
Buncombe County, North Carolina.
Calistoga, California.
Chalk Creek Hot, Colorado.
Charleston Artesian, South Carolina.
Des Cahutes Hot, Oregon.
Seltzer, California.
Sheldon, Vermont.
Summit Soda, California.
Vichy, California.
Wilholt Soda, California.

Calcic:

Bethesda, Wisconsin.
Butterworth, Michigan.
Birch-Dale, Vermont.
Clarendon, Vermont.
Eaton Rapid, Michigan.
Gettysburg, Pennsylvania.
Hubbardstown, Michigan.
Silurian, Wisconsin.

Chalybeate:

Abbeville, South Carolina.
Alma, Michigan.
Bedford, Pennsylvania.
Blossburg, Pennsylvania.
Cooper's Well, Mississippi.
Esbitt, Kentucky.
Fayette, Pennsylvania.

Dremion, Kentucky.
French Lick, Indiana.
Glenn's, South Carolina.
Gordon's, Georgia.
Highgate, Vermont.
Indian, Georgia.
Indian, Indiana.
Lodi Artesian, Indiana.
Manley, North Carolina.
Minnequa, Pennsylvania.
Montesano, Missouri.
Olympian, Kentucky.
Portea Springs, Colorado.
Salt Sulphur, Virginia.
Saratoga, New York.
Sharon, New York.
Sheldon, Vermont.
Shocco, North Carolina.
St. Helena White Sulphur, California.
St. Louis, Michigan.
Sweet, Missouri.
Valhemosa, Alabama.
West Baden, Indiana.
White Sulphur, Louisiana.
White Sulphur, Montana.
White Sulphur, Virginia.

Unclassified:
Alum, Virginia.
Birch-Dale, New Hampshire.
Borax, California.
Climax, Missouri.
Eureka, Arkansas.
Fairview, Texas.
Geysers, the American, Wyoming.
Geyser Spa, California.
Greeneleone, Florida.
Harbines, California.
Hot Springs, Arkansas.
Idaho Hot, Colorado.
Iodide and Bromide, Missouri.
Merriweather, Georgia.
Middle Park Hot, Colorado.
Ojo Caliente, New Mexico.
Paraiso, California.
Passo Robles, California.
Piedmont, Texas.
Salt Lake, Utah.
Seigler, California.
Skaggs, California.
Stafford, Connecticut.
Volcano, Nebraska.
Warm and Hot, West Virginia.

DRUGS ACTING CHIEFLY ON THE GASTRO-INTESTINAL ORGANS.

BITTERS.

SIMPLE BITTERS.

Quăssia—Quăssiæ—Quassia. *U. S. P.*

Definition.—The wood of *Picrasma excelsa* (Swz.) Plancon, known commercially as Jamaica quassia or of *Quassia amara* L., known commercially as Surinam quassia.
Description and Properties.—In the shops it is usually met with in the form of chips or raspings of a yellowish-white color, or in billets (Surinam). Quassia contains two bitter principles—*quassin* and *picrasmin*. It contains *no tannin*.
Dose.—10–30 grains (0.6–2.0 Gm.) [7½ grains (0.55 Gm.), U. S. P.].

Official Preparations.

Extrăctum Quăssiæ—Extrăcti Quăssiæ—Extract of Quassia.—*Dose*, 1–3 grains (0.065–0.2 Gm.).
Fluidextrăctum Quăssiæ—Fluidextrăcti Quăssiæ—Fluidextract of Quassia.—*Dose*, 10–30 minims (0.6–2.0 Cc.) [average dose, 8 minims (0.5 Cc.), U. S. P.].
Tinctūra Quăssiæ—Tinctūræ Quăssiæ—Tincture of Quassia.—*Dose*, 30 minims (2 Cc.).

Gentiāna—Gentiānæ—Gentian. *U. S. P.*

Origin.—The dried rhizome and roots of *Gentiana lutea* L., a plant from 2 to 3 feet high, indigenous in the mountainous portions of Central Europe.
Description and Properties.—It appears in nearly cylindrical pieces or longitudinal slices about 1 inch (25 Mm.) thick, the upper portion closely annulate, the lower longitudinally wrinkled; externally deep yellowish-brown; internally lighter; somewhat flexible and rather thick, separated from the subspongiose medulla by a black cambium line. Odor peculiar, faint, stronger when moistened; taste sweetish and persistently bitter. Gentian contains a bitter glycoside (*gentiopicrin*) and also *gentisic acid*, to which its yellow color is due. It contains about 15 per cent. of glucose, but *no starch* nor pure *tannin*.
Dose.—5–30 grains (0.3–20 Gm.) [15 grains (1 Gm.), U. S. P.].

Official Preparations.

Extrăctum Gentiānæ—Extrăcti Gentiānæ—Extract of Gentian.—*Dose*, 2–10 grains (0.12–0.6 Gm.) [4 grains (0.25 Gm.), U. S. P.].
Fluidextrăctum Gentiānæ—Fluidextrăcti Gentiānæ—Fluidextract of Gentian.—*Dose*, 5–30 minims (0.3–2.0 Cc.) [15 minims (1 Cc.), U. S. P.].
Tinctūra Gentiānæ Compŏsita—Tinctūræ Gentiānæ Compŏsitæ—Compound Tincture of Gentian.—*Dose*, 1–2 fluidrams (4.0–8.0 Cc.) [1 fluidram (4 Cc.), U. S. P.]. 10 per cent. with orange peel and cardamom.

Calŭmba—Calŭmbæ—Calumba. *U. S. P.*

(Columbo.)

Origin.—The dried root of *Jateorhiza palmata* (Lam.) Miers., a plant native to the forests of Eastern Africa and Madagascar, and cultivated in the East Indies.
Description and Properties.—Nearly circular disks, 1 to 2 inches (25–50

Mm.) in diameter and ¼ to ½ inch (6–12 Mm.) thick. Externally greenish-brown and wrinkled; internally yellowish or grayish-yellow; depressed in the center, with a few interrupted circles of projecting wood-bundles; distinctly radiate in the outer portion; fracture short, mealy; odor slight; taste mucilaginous, slightly aromatic, very bitter. It contains a bitter crystalline principle (*calumbin, calumbic acid, berberine*) and starch. *No tannin* is present.

Dose.—10–60 grains (0.6–4.0 Gm.) [30 grains (2 Gm.), U. S. P.

Official Preparations.

Fluidextrăctum Calŭmbæ—Fluidextrăcti Calŭmbæ—Fluidextract of Calumba.—*Dose*, 10–60 minims (0.6–4.0 Cc.) [30 minims (2 Cc.), U. S. P.].

Tinctūra Calŭmbæ—Tinctūræ Calŭmbæ—Tincture of Calumba (20 per cent.).—*Dose*, 1–4 fluidrams (4.0–15.0 Cc.) [1 fluidram (4 Cc.), U. S. P.].

Calĕndula—Calĕndulæ—Calendula. *U. S. P.*

(MARIGOLD.)

Origin.—The dried ligulate florets of *Calendula officinalis* L., an annual plant, a native of the Levant and Europe, frequently cultivated as a garden ornament.

Description and Properties.—Florets about ½ inch (12 Mm.) long, linear and strap-shaped, delicately veined longitudinally, yellow or orange-colored, three-toothed at the apex, the short, hairy tube enclosing the remnants of a filiform style elongately cleft. Odor slight and somewhat heavy; taste rather bitter and faintly saline. It contains a peculiar gummy principle, *calendulin*, a bitter constituent, and a trace of volatile oil.

Dose.—5–30 grains (0.3–2.0 Gm.) [15 grains (1 Gm.), U. S. P.].

Official Preparation.

Tinctūra Calĕndulæ—Tinctūræ Calĕndulæ—Tincture of Calendula (20 per cent.).—*Dose*, 15–60 minims (1.0–4.0 Cc.).

Chirāta—Chirātæ—Chirata. *U. S. P.*

Origin.—The dried plant *Swertia Chirayita* (Rox.) Hamilton, an annual, native to Northern India.

Description and Properties.—Chirata, as found in the shops, consists of short sections of the stem and branches pressed and split, brown or dark-purple in color, and mixed with a few leaves and flowers. It contains a very bitter yellow principle, a hygroscopic glycoside (*chiratin*), a bitter syrupy liquid (*ophelic acid*), a resin, coloring-matter, etc. No tannin is present.

Dose.—5–20 grains (0.3–1.3 Gm.) [15 grains (1 Gm.), U. S. P.].

Official Preparation.

Fluidextrăctum Chirātæ—Fluidextrăcti Chirātæ—Fluidextract of Chirata.—*Dose*, 5–20 minims (0.3–1.3 Cc.) [15 minims (1 Cc.), U. S. P.].

AROMATIC BITTERS.

Ănthemis—Anthĕmidis—Anthemis. *U. S. P.*

(CHAMOMILE.)

Origin.—The dried flower-heads of *Anthemis nobilis* L., a low perennial plant indigenous in Southern and Western Europe.

Description and Properties.—Heads subglobular, about ¾ inch (2 Cm.) broad, consisting of an imbricated involucre and numerous white, strap-shaped, three-toothed florets, and a few, if any, yellow tubular disk-florets, inserted upon a chaffy, conical, solid receptacle; of a strong, agreeable odor and an aromatic, bitter taste.

Anthemis contains a bitter principle, a pale-blue or yellowish-brown volatile oil, and a trace of tannin, together with other unimportant constituents.

Dose.—15–60 grains (1.0–4.0 Gm.) [30 grains (2 Gm.), U. S. P.], in infusion or fluidextract.

Prūnus Virginiāna—Prūni Virginiāna—Wild Cherry. *U. S. P.*

Origin.—The bark of *Prunus serotina* Ehr, which should be collected in autumn.

Description and Properties.—It is met with in curved pieces or irregular fragments $\frac{1}{12}$ inch (2 Mm.) or more thick; outer surface greenish-brown or yellowish-brown, smooth and somewhat glossy, marked with transverse scars. If the bark is collected from the old wood and deprived of the corky layer, the outer surface is nut-brown and uneven; inner surface somewhat striate or fissured. Upon maceration in water it develops a distinct bitter-almond odor. Taste astringent, aromatic, and bitter. It contains tannin, resin, a glycoside—*amygdalin* (*laurocerasin*), and a ferment—*emulsin*. In the presence of water the *glycoside* is broken up into *hydrocyanic acid* and a *volatile oil*. Benzaldehyd results also from the ferment action. Temperature above 160° F. destroys the action of the ferment.

Dose.—½–1 dram (2.0–4.0 Gm.) [30 grains (2 Gm.), U. S. P.].

Official Preparations.

Fluidextrāctum Prūni Virginiānæ—Fluidextrācti Prūni Virginiānæ—Fluidextract of Wild Cherry.—*Dose*, 30–60 minims (2.0–4.0 Cc.) [30 minims (2 Cc.), U. S. P.].

Infūsum Prūni Virginiānæ—Infūsi Prūni Virginiānæ—Infusion of Wild Cherry.—*Dose*, 1–2 fluidounces (30.0–60.0 Cc.) [2 ounces (60 Cc.), U. S. P.].

Sȳrupus Prūni Virginiānæ—Sȳrupi Prūni Virginiānæ—Syrup of Wild Cherry.—*Dose*, 2–4 fluidrams (8.0–15.0 Cc.) [1 dram (4 Cc.), U. S. P.].

Serpentāria—Serpentāriæ—Serpentaria. *U. S. P.*

(VIRGINIA SNAKEROOT.)

Origin.—The dried rhizome and root of *Aristolochia Serpentaria* L. (Virginia Serpentaria) or *Aristolochia reticulata* Nutt. (Texas Serpentaria), perennial herbs indigenous in the United States.

Description and Properties.—The rhizome of Virginia serpentaria is about 1 inch (25 Mm.) long, thin, curved; on the upper side with approximate, short stem-bases; on the lower side with numerous thin, branching roots about 4 inches (10 Cm) long; dull yellowish-brown, internally whitish; the wood-rays of the rhizome are longest on the lower side; odor aromatic, camphoraceous; taste warm, bitterish, and camphoraceous. It contains ½ per cent. of *volatile oil*, a bitterish principle *aristolochin*, tannin, resin, starch, etc. The roots of *Aristolochia reticulata* are coarser, longer, and less interlaced than those of *Aristolochia Serpentaria*.

Dose.—10–30 grains (0.6–2.0 Gm.) [15 grains (1 Gm.), U. S. P.].

Official Preparations.

Fluidextrāctum Serpentāriæ—Fluidextrācti Serpentāriæ—Fluidextract of Serpentaria.—*Dose*, 10–30 minims (0.6–2.0 Cc.) [15 minims (1 Cc.), U. S. P.].

Tinctūra Cinchōnæ Compŏsita—Tinctūræ Cinchōnæ Compŏsitæ—Compound Tincture of Cinchona.—*Dose*, 1–4 fluidrams (4.0–15.0 Cc.) (2 per cent. of serpentaria).

Tinctūra Serpentāriæ—Tinctūræ Serpentāriæ—Tincture of Serpentaria (20 per cent.).—*Dose*, ½–2 fluidrams (2.0–8.0 Cc.) [1 dram (4 Cc.), U. S. P.].

Antagonists and Incompatibles.—The salts of iron, lead, and silver are incompatible with gentian and the aromatic bitters, though preparations of iron can be given with quassia, calumba, and chirata. Boiling water impairs the virtues of wild cherry.

Synergists.—The digestants, mineral acids, and, under certain conditions, alkalies, and the restorative agents generally, aid the action of vegetable bitters.

Physiological Action.—Because of their action in augmenting the secretions from the salivary and gastric glands, they aid digestion and improve nutrition.

Pure bitters act immediately upon contact; that is, their efficiency is due to their local action upon the mucous membrane of the mouth, tongue, and esophagus.

Bitters increase the secretion from the salivary glands. This effect is produced by stimulating the ends of the nerves of taste distributed in the mucous membrane of the mouth, from which nerves the impression is conveyed to the center in the medulla, and from there transmitted to the vasomotor and secretory nerves supplying the salivary glands, increasing their blood-supply and activity and at once promoting the secretion of saliva.

Bitters increase the secretion from the gastric glands. The primary action is an augmented flow of gastric juice, caused by reflex stimulation from the mouth. It is well known that there is an intimate relationship between the stomach and the senses of taste and smell. The taste of victuals or the odor of a tempting dinner excites the appetite, and, reflexly, the flow of gastric juice, similar to the flow of saliva in a dog looking wistfully at a meat-stand. Bitters act in a similar manner. The nerves of taste are stimulated; the impression is conveyed to the medulla, and from it transmitted not only to the salivary glands, but through the fibers of the vagus, increasing the blood-supply to the gastric glands and thereby promoting their functional activity.

Bitters stimulate the peristaltic movements of the stomach by reflex action. The sensory nerves in the mucous membrane are irritated, and an impression is conveyed by them to Auerbach's plexus between the muscles in the walls of the stomach, from which plexus, or ganglion, the influence is transmitted to the muscles themselves, causing increased activity or peristalsis.

Another method by which peristalsis is stimulated occurs when the impression is conveyed by the sensory nerves directly to the center in the medulla, and from there through the motor fibers of the vagus to Auerbach's plexus, affecting the muscles in the manner just described.

Bitters augment absorption by increasing the blood-supply to the mucous membrane of the stomach. It is a physiological fact that the larger the blood-supply passing through the blood-vessels, and the greater the amount of lymph conveyed through the lymph-channels, the more rapid the absorption.

Bitters also induce leukocytosis. Their action as antiseptics is secondary to the increase of the gastric juice, digestion being a physiological fermentative process, forming a contraindication to the administration of bitters during active digestion.

Therapeutics.—*Externally and Locally.*—The tincture of calen-

dula is recommended by many physicians as an external application for *contusions*, *sprains*, etc., although not so efficient as tincture of arnica. The drug has been used topically in *chronic pharyngitis*.

Internally.—The simple bitters are peculiarly useful in *atonic and fermentative dyspepsia*, *chronic gastric catarrh*, and as a tonic in *convalescence from acute disease*, in *malarial fever*, and in the *anorexia* following it.

Infusion of QUASSIA is a most efficacious injection to destroy *seat-worms* (*Oxyuris vermicularis*), the infusion being injected into the rectum, which has been previously washed out with soap and water and cleared of mucus by salines.

The aromatic bitters are used to stimulate the appetite and improve the condition of the digestive apparatus. The simple bitters are similarly used, but the former possess more stimulating and tonic properties, owing to their volatile and astringent constituents. CHAMOMILE, in addition to its action as a stimulant to the digestion, has been employed with benefit in *delirium tremens* and as an *emmenagogue*, while in the form of hot poultices chamomile flowers serve as an efficient application for *local pains*.

WILD CHERRY might not inaptly be called a sedative tonic, its peculiarly bitter, yet not unpleasant taste causing it to be well tolerated by the stomach, and rendering it one of the best stomachic tonics, especially during convalescence, when its sedative action upon the heart allays febrile and cardiac excitement. The syrup of wild cherry is a common ingredient of "cough-syrups." It is thought to quiet the cough and allay the irritability of the nervous system in *bronchitis* and *phthisis*—probably owing to the hydrocyanic acid which it contains.

SERPENTARIA is considered an efficient expectorant in *pneumonia* and *capillary bronchitis*. Next to its use as a stomachic its chief value seems to be as a stimulant in *typhus* and *typhoid fevers*, the compound tincture of cinchona being a most excellent remedy in the low forms of typhoid. Bitter orange is widely employed as a pleasant bitter. Cinchona and nux vomica make most efficient bitters.

Contraindications.—Bitters should not be given when the secretion of gastric juice is diminished as the result of organic disease. They are contraindicated as stomachics during the course of acute disease, as in *fevers*. When after a reasonable time they fail to improve the appetite, they should be discontinued. In convalescence from acute disease, when the appetite is voracious, they are contraindicated. Bitters find their chief usefulness in the depressed and hypochondriacal states of fatigue from a vast variety of sources, and in which there is loss of appetite.

Administration.—To improve the appetite bitters should be given from one-half to one hour *before* meals. When necessary to use them for a long time, one bitter should be substituted for another in the course of every week or two; otherwise the stomach

may rebel at the monotony. Bitters may be given in the form of a powder or a solid extract. Ordinarily, however, it is preferable to administer a liquid preparation—fluidextract, tincture, or infusion. A pleasant method of giving the latter preparation in the case of quassia is to allow water to stand overnight or for a few hours in a quassia-cup—purchasable at almost any drug store—when the water will become impregnated with the bitter principle of the quassia.

DIGESTANTS.

Pepsīnum—Pepsīni—Pepsin. *U. S. P.*

Origin.—A proteolytic ferment or enzyme obtained from the glandular layer of fresh stomach of the hog *Sus scrofa*, and capable of digesting not less than 3000 times its own weight of freshly coagulated and disintegrated egg albumin when tested by the process given in the United States Pharmacopœia.

Description and Properties.—A fine white, or yellowish-white, amorphous powder, or thin, pale-yellow, or yellowish, transparent or translucent grains or scales, free from offensive odor, and having a mildly acidulous or slightly saline taste, usually followed by a suggestion of bitterness. It slowly attracts moisture when exposed to the air. Soluble, or for the most part soluble, in about 50 parts of water, with more or less opalescence; more soluble in water acidulated with hydrochloric acid; insoluble in alcohol, ether, or chloroform. Pepsin usually has a slightly acid reaction. It may be neutral, but should never be alkaline.

Dose.—5–60 grains (0.3–40 Gm.) [4 grains (0.25 Gm.), U. S. P.].

Antagonists and Incompatibles.—Tannic and gallic acids are incompatibles. Mineral salts, alcohol more than 10 per cent., and alkalies precipitate pepsin from solution, the latter two impairing its digestive property.

Synergists.—Diluted hydrochloric acid, in not over $\frac{2}{10}$ of 1 per cent., increases its digestive action.

Physiological Action.—Its only influence seems to be upon the digestive system. Pepsin is a typical restorative, being a normal constituent of the gastric juice, and in the presence of hydrochloric acid digesting the proteid elements of the food, converting them into albumoses, and finally into peptones.

Therapeutics.—*Externally and Locally.*—Its digestive action is utilized to dissolve or digest the false membrane in *diphtheria* and *croup*. A solution of pepsin has also been injected into the bladder to digest blood-clots.

Internally.—As a restorative, where there is a lessened secretion of gastric juice, *atonic dyspepsia*, *apepsia* of infants, *cancer of the stomach*, and *gastric ulcer*, pepsin has proved serviceable. It is also employed to favor digestion in convalescence from acute and long illness. It is frequently necessary to give pepsin, or "peptonized milk." in acute *dyspeptic diarrhea* of infants.

Administration.—Pepsin should be given in powder or dissolved in glycerin (glycerol of pepsin), or in water acidulated with hydrochloric acid, directly after meals.

The drug should not be given continuously for too long a period, lest the function of the stomach become impaired from

disuse, the artificial digestion having replaced the natural, normal process.

Unless there be some direct indication for its use, rather than give pepsin it is better to stimulate the gastric glands to secrete a larger amount of their normal juice, that they may not lie idle, and their function be consequently impaired by disuse. Hydrochloric acid administered with pepsin probably promotes glandular activity slightly. Often, however, pepsin must be given, and in certain patients the stomach is in such a condition that nutrient enemats must be administered. Yet, since the rectum possesses very feeble powers of digestion, foods should always be predigested. Suppositories of peptonized meat are frequently used for this purpose.

Pancreatīnum—Pancreatīni—Pancreatin. *U. S. P.*

Origin.—A mixture of the enzymes naturally existing in the pancreas of warm-blooded animals, usually obtained from the fresh pancreas of the hog or the ox, and consisting principally of amylopsin, myopsin, trypsin, and steapsin, and capable of converting not less than 25 times its own weight of starch into substances soluble in water.

Description and Properties.—A yellowish, yellowish-white, or grayish amorphous powder, odorless, or having a faint, peculiar, not unpleasant odor, and a somewhat meat-like taste. Slowly and almost completely soluble in water, insoluble in alcohol.

Pancreatin digests albuminoids and all proteid substances, converts starch into sugar, and, when not over twenty-four hours old, aids in the digestion of fats. Prolonged contact with mineral acids renders it inert.

Dose.—10–20 grains (0.6–1.2 Gm.) [7½ grains (0.5 Gm.), U. S. P.].

Antagonists and Incompatibles.—Strong mineral acids.

Synergists.—Weak alkalies.

Physiological Action.—The four ferments which it contains render it capable, in either weak alkaline or acid media, of digesting proteid foods, emulsifying fats and oils, and resolving them into fatty acids and glycerin, converting starch into sugar, and curdling milk.

Therapeutics.—Like pepsin, it is used as an artificial agent in certain disorders of digestion.

Administration.—It may be given dry, in powder, capsules, or compressed pills, or in solution. It should be administered in combination with an alkali, as the activity of pancreatin is destroyed by acids, and should be given ordinarily from two to four hours after meals, when the chyme has entered the intestine. It may also be administered immediately after eating or with the food, since there is an interval of from fifteen minutes to half an hour after the ingestion of food before the stomach-contents are rendered sufficiently acid by the gastric juice to interfere with the activity of the pancreatin.

For rectal nourishment pancreatin is preferable to pepsin, because of its superior action in predigesting food.

Pankreon is a recently introduced dried mixture of the pancreatic emzymes.

Papain, Papoid, or Papayotin. (*Non-official.*)

Origin.—The inspissated juice of the unripe fruit of *Carica Papaya.*

Description and Properties.—A whitish, slightly astringent powder, soluble in water.

Dose.—1–8 grains (0.06–0.5 Gm.).

Antagonists and Incompatibles.—Tannic and gallic acids. Lead salts and alcohol are incompatible with papain.

Synergists.—The digestive ferments.

Physiological Action.—In this it resembles pepsin, though differing from the latter, as well as from pancreatin, in that it is equally active in neutral, alkaline, or acid media. It converts proteids into soluble peptones, and acts as a stimulant to the gastric glands. It converts starch into maltose, and upon false membranes acts more energetically than pepsin. It may dissolve intestinal worms.

Therapeutics.—*Externally.*—The uses of papain are more manifold than those of the digestive ferments previously mentioned. Like pepsin, it has been successfully employed to dissolve false membrane in *diphtheria* and *croup.* The juice of pineapple, which possesses a ferment (bromelin) similar to that of papain, is a valuable domestic remedy in these diseases. Papain has been used with some benefit in *indurated ezcema* and in *syphilitic ulcerations* of the *tongue.* It has been highly recommended by Johnston as a *solvent* of *cerumen:* 15 drops (1 Cc.) of a solution of 20 grains to 1 ounce (1.2 Gm. to 30 Cc.) of distilled water are dropped into the outer meatus, and the parts syringed an hour afterward with a solution of boric acid.

Internally, papain may be used for the same purposes as pepsin and pancreatin; yet, while hypothetically superior, it is practically inferior to them, fortunately not having supplanted them in actual practice.

Administration.—When used to aid digestion, papain should be given after meals, either in powders, capsules, compressed tablets, or aqueous solution, freshly prepared.

Amylolytic Enzymes.

In the germination of many seeds the starches contained therein are converted by enzymes into soluble starch or sugars, and thus nourish the young plant. Many bacteria are capable of breaking down starches, as well as proteids, and some moulds develop amylolytic, as well as proteolytic, enzymes of marked activity.

Of late years much use has been made of a number of these enzymes. That from grain—barley, malt—containing the enzyme *diastase* has been widely used, especially in proprietary medicines.

Măltum—Mălti—Malt. *U. S. P.*

Definition.—The grain of barley, *Hordeum distichon* L., partially germinated artificially and then dried.

Extrăctum Mălti—Extrăcti Mălti—Extract of Malt. *U. S. P.*

This and Maltum are reintroductions into the Pharmacopœia of articles admitted to the 1880 revision but dismissed in 1890; it is contained in the National Formulary.

Description and Properties.—Malt extract consists of easily assimilable carbohydrates—maltose and dextrin—and small quantities of proteids; the ash contains the phosphates of calcium and magnesium. If the malt has not been overheated (by which the diastase would be destroyed), and if the extract is prepared according to the U. S. Pharmacopœia process, the preparation, when fresh, will contain diastase, which is an efficient ferment for the conversion of starch into dextrose; the diastatic, power, however, rapidly deteriorates on keeping.

Dose.—Average dose: 4 fluidrams (16 Cc.), U. S. P.

Diastase prepared from malt that has not been heated above 135° F. is capable, in neutral or very slightly acid or alkaline solutions, of digesting appreciable quantities of starch. It is doubtful, however, if this action will take place in the stomach to any appreciable extent, and still more doubtful if, in the treatment of what has been termed starchy indigestion—amylaceous dyspepsia—such malt compounds are of any service. The clinical evidence adduced to the efficiency of such compounds should be taken with caution.

One amylolytic ferment from a mould, the *Aspergillus oryzæ* (Ahlburg), which has been utilized in the breweries of Japan for centuries, particularly in the production of the Japanese rice wine (Saké), has been introduced within recent years into pharmacotherapeutics under the name of *taka-diastase.* It is very active, but it is quite doubtful if it has any particular action on the undigested starch found in the intestines after it has been in the stomach for any length of time. Excellent clinical observers report good results, and it is deserving of trial. In all questions concerning the action of foreign ferments it should be remembered that they are largely foreign proteid bodies and are probably broken up and digested as such, apart from their action as enzymes, by the natural enzymes of the digestive tract, notably by pepsin.

FATS AND OILS.

Ōleum Mŏrrhuæ—Ōlei Mŏrrhuæ—Cod-liver Oil. *U. S. P.*

Origin.—A fixed oil obtained from the fresh livers of *Gadus morrrhua* L. and other species of *Gadus.*

Description and Properties.—A pale-yellow, thin, oily liquid, having a peculiar, slightly fishy, but not rancid odor, and a bland, slightly fishy taste. Specific gravity 0.918 to 0.922 at 25° C. (77° F.). Scarcely soluble in alcohol, but readily soluble in ether, chloroform, or carbon disulphide, also in 2.5 parts of acetic ether. It contains glycerides of stearin and palmitin, traces of iodine, bromine, chlorine, biliary salts, phosphoric and sulphuric acids, and several alkaloids (leucomains), possibly decomposition-products. The most important of these, isolated by Gautier, are butylamine, hexylamine, amylamine, asseline, and morrhuine. It is doubtful if any one active principle exists in this oil.

MORRHUOL, a name given by Chapoteaut to a mixture of the various alkaloids and important principles of cod-liver oil, occurs as an amber-brown, bitter, aromatic liquid.

Dose.—1–4 fluidrams (3.8–15.0 Cc.) [4 fluidrams (16 Cc.), U. S. P.].

Emŭlsum Ōlei Mŏrrhuæ—Emŭlsi Ōlei Mŏrrhuæ—Emulsion of Cod-liver Oil. *U. S. P.*

A standard official preparation, containing 50 per cent. of cod-liver oil. It may be flavored to suit the taste, with oil of gaultheria, oil of bitter almond, etc.

Dose.—Average dose: 2 fluidrams (8 Cc.), U. S. P.

Emŭlsum Ōlei Mŏrrhuæ cum Hypophosphītibus—Emŭlsi Ōlei Mŏrrhuæ cum Hypophosphītibus—Emulsion of Cod-liver Oil with Hypophosphites. *U. S. P.*

Similar to oleum morrhuæ, but containing the hypophosphites of calcium, potassium, and sodium.

Dose.—Average dose: 2 fluidrams (8 Cc.), U. S. P.

Physiological Action.—*Externally and Locally.*—It possesses emollient properties, and may be applied to the skin and mucous membranes without causing irritation. It slightly reduces temperature in fever when applied to the body.

Internally.—Fat is a normal and necessary constituent of the body. It is the fuel used to supply energy, and those tissues and organs which are the most active require the most fat. Consequently, nerves, muscles, and glands are more abundantly furnished with fat than cartilage, and in cases of starvation those structures demanding the greater supply must have it, at the expense of the less highly organized and active tissues—as is seen in the great emaciation preceding the decline of mental powers. The blood contains about one-half of 1 per cent. of fat; the muscles, 3 per cent.; the brain, 8 per cent.; and the nerves 22 per cent. In order, therefore, that the various cells of the body may possess sufficient vitality to withstand by physiological resistance the encroachments of disease and the invasion of pathogenic micro-organisms, this equilibrium must be maintained. Yet this necessary food, fat, is more frequently deficient than any other, from the difficulty either of obtaining a supply or of digesting and assimilating it.

Before oils or fats can enter the various cells and act as food, and consequently be a source of power, they must be digested and assimilated by the body. The value of an oil is based upon: (1) Its rate of absorption; (2) its rate of oxidation; (3) its agreeable taste.

Cod-liver oil, while to many persons repugnant in taste, is more readily absorbed and oxidized than any other fat. It has already been prepared by the liver, and therefore partly elaborated, and, owing to the biliary salts which it contains, it passes more readily through animal membranes. Moreover, Naumann has shown that cod-liver oil is more easily oxidized than any other oil, rendering this substance almost an ideal ready-made food. Its actions upon the several systems are here considered.

Digestive System.—Large doses disturb the stomach and may

even occasion vomiting, but in medicinal doses alone, or in the form of an emulsion, it may be taken usually without discomfort, in some cases even increasing the appetite. In the stomach cod-liver oil is unaffected, but in the intestines it meets the pancreatic juice, which resolves a portion of it into glycerin and fatty acids, the latter combining with the alkalies of the bile and the intestinal juice to form soaps, while the remaining, and larger, portion is emulsionized by the alkaline secretions of the intestines.

Circulatory System.—The number of red corpuscles is increased, and the quality of the blood is greatly improved.

Nervous System.—This shares, with the other tissues of the body, the general amelioration, the drug being a food and tonic to the brain and nerves.

Respiratory System.—No special action is noticeable other than the natural improvement in the respiratory power incidental to better blood and an increased functional activity of the nerves and muscles.

Absorption and Elimination.—Cod-liver oil can be absorbed only after it enters the intestines. The glycerin and fatty acids formed by the pancreatic and the intestinal juices, together with the soaps produced by the action of the bile, are readily absorbed by the mucous membrane.

The oil remaining, as has been stated, is emulsionized—that is, it is subdivided into minute globules, each enclosed in an envelope composed of alkaline albuminate and soap, which has a great affinity for the mucous membrane and carries the oil through the columnar epithelium of the intestinal villi into the lymph-spaces. The osmosis inward of the oil-emulsion is rendered still easier by the action of the bile with which the mucous membrane is bathed.

It will be seen that much of the oil taken into the system is oxidized, being subsequently excreted as carbonic acid and water.

Temperature.—When taken internally the temperature is unaffected, but, as has been observed, when applied to the epidermis the bodily heat is reduced.

Untoward Action.—In addition to disturbances of digestion sometimes occasioned by moderate doses, cod-liver oil at times produces a vesicular eczema which may spread over the entire body. This eruption is probably caused by the volatile fatty acids which the oil contains. At times it may cause a diarrhea.

Poisoning.—Cod-liver oil possesses no poisonous action.

Therapeutics.—*Externally and Locally.*—Cod-liver oil is much used by dermatologists in diseases of the skin, being especially serviceable in softening the crusts of *eczema*. It has been applied to the skin to *allay irritation* and for the *reduction of temperature* in the *exanthemata*.

Daily inunctions are beneficial in *chronic scaly skin diseases*, while a local application to the chest has seemed at times to influence favorably the course of *pertussis*.

Internally.—For two or three centuries cod-liver oil has been

used both externally and internally for *chronic rheumatism*, but it is only since 1841 that it has been employed in the treatment of *tuberculosis*. While to-day it does not receive the enthusiastic support which attended its introduction in the latter disease, it is nevertheless a standard and highly efficacious remedy in the various forms of the disorder. It is equally valuable in *scrofulous affections*, and even more potent in *rachitis*. *Chronic bronchitis* is perhaps more frequently relieved by its use than by any other internal remedy. Diseases resulting in *anemia* are usually more benefited by cod-liver oil than by other remedial agents. *Chronic arthritis*, *fistula* and *abscess* in the neighborhood of the joints, have been greatly improved by its use. *Atheroma of the arteries* and many *cutaneous diseases*, particularly the *strumous* variety, and *syphilodermata* yield to its alterative and nutrient properties.

Probably no single drug is employed in *nervous diseases* with effects so markedly beneficial as those of cod-liver oil. While possessing no specific action, it increases the strength and vitality of the patient, enabling him to resist morbid tendencies more successfully, and, by improving the condition of the nerves, lessens the liability to nervous derangement.

Diabetes mellitus and *Bright's disease*, with anemia yet unattended by marked digestive disturbance, are decidedly improved by the administration of cod-liver oil.

Should no gastric disorder supervene, this remedy should invariably be given in the last-named diseases. It certainly serves to maintain the general health, and is singularly efficacious in prolonging the lives of the afflicted patients, enabling them to profit by hygienic measures, upon which great reliance should be placed. The tonic and nutritive properties of the drug have been strikingly shown in the rapid improvement of patients *convalescing* from *acute diseases*. In *catarrhal conditions*, especially in *ozena* and *otitis* following measles and scarlet fever, it is of marked benefit.

Without entering upon specific considerations other than the above, it will be seen that cod-liver oil is indicated whenever there is defective activity, whether inherited or acquired.

Contraindications.—It is to be remembered that cod-liver oil is a food and not a medicine: it is therefore contraindicated in all diseases where it proves detrimental to the appetite, causing eructation, heartburn, diarrhea, etc. It is usually contraindicated in fevers, owing to the suspension of the secretions and impairment of digestion characteristic of acute febrile disorders.

Administration.—In the early use of cod-liver oil it is advisable to prescribe small doses, that its toleration by the stomach may be gradually acquired. To many patients, however, it is extremely distasteful, and the repugnance is increased rather than lessened by continued use. In such cases it is better, if possible, to disguise the taste and smell in some manner rather than to abandon so valuable a remedy when clearly indicated. Various means have been employed for this purpose. An emulsion may

be made which obviates its disagreeable qualities. There are in the market soft capsules containing this oil that serve an excellent purpose, being easily swallowed and disguising completely the taste and odor of the drug. Administration should occur ordinarily some time after meals, that the oil may reach the intestines as soon as possible.

EMETICS.

Emetics are agents which produce vomiting or *emesis*.

Emesis is, in short, an antiperistaltic action, complex in its mechanism. Emetics are largely out of fashion in medicine at the present time, but are in so much demand when needed, particularly in poisoning, that their consideration is worthy of separate treatment.

The local or gastric emetics[1] are:

* Alum;	* Yellow mercuric sulphate;
* Copper sulphate;	* Sodium chloride;
* Zinc sulphate;	* Ammonium carbonate;

* Mustard.

Apomorphine hydrochloride, antimony and potassium tartrate, ipecacuanha, and lobelia are thought to be medullary emetics.

Local or gastric emetics are the more rapid in their action, producing emesis in from two to five minutes. The systemic emetics must be absorbed and pass to the medulla before they produce vomiting, consequently requiring more time to exert their influence. Moreover, the action of the latter class of emetics is of much longer duration and followed by greater depression of the muscular and circulatory systems, together with greater constitutional disturbance.

Some emetics act both locally and centrally. Tartar emetic and ipecacuanha affect the stomach locally, and it has recently been called in question whether their medullary action is even present, not to say important. Zinc sulphate and copper sulphate, while to a slight extent acting on the medulla, are classed as local emetics, because their principal action is upon the mucous membrane of the stomach.

Within a few minutes after an emetic has been ingested there is a feeling of nausea and distress, with decided muscular relaxation. The circulatory system is depressed; the pulse is small and irregular, and a sensation of faintness ensues. The flow of saliva is increased, and vomiting soon follows. During emesis the arterial tension is raised, the face is flushed, and there is an increase in bodily heat. When vomiting has subsided there is a reduction of temperature, with cardiac and muscular weakness, the skin being bathed in perspiration. Occasionally fatal syncope has followed the use of emetics.

[1] (The drugs marked with an asterisk (*) are considered elsewhere in the present work.)

Antagonists.—Drugs known as Antiemetics are used to allay nausea and check vomiting. Like emetics, these agents are divided into Local Antiemetics or Gastric Sedatives and Direct or Systemic Antiemetics, according to their action.

Among the most important Antiemetics are the following:

Local Antiemetics or Gastric Sedatives.

(All of these are discussed elsewhere in the present work.)

Alcohol (especially champagne);
Arsenic (small doses);
Belladonna;
Bismuth subnitrate and subcarbonate;
Carbolic acid;
Cerium oxalate;
Chloroform;
Cocaine;
Creasote;
Calomel (small doses);
Ether;
Ipecac (small doses);
Ice;
Opium;
Hydrocyanic acid;
Menthol;
Potassium nitrate;
Silver nitrate;
Sulphocarbolates;
Tincture of iodine (small doses).

Direct or Systemic Antiemetics or Gastric Sedatives.

Alcohol;
Ammonium;
Amyl nitrite·
Bromides;
Chloral;
Hydrocyanic acid;
Nitroglycerin;
Opium.

It will be observed that some drugs are both local and direct antiemetics.

There are certain measures which may be adopted to allay nausea and relieve vomiting, such as a recumbent posture and injection of large quantities of aerated water into the rectum.

Synergists.—The emetics are, of course, mutually synergistic. Emetics are adjuncts to antiperiodics and expectorants, although the latter do not particularly enhance the action of the former.

Emetic are used:

1. *To empty the stomach* in cases where the presence of undigested food occasions pain, headache, etc., or to expel some poisonous substance from the stomach. For this purpose the local emetics are preferable.

In cases of poisoning the local emetics are the more reliable.

2. *To remove foreign bodies from the esophagus.* For this purpose the direct or systemic emetics should be used.

3. *To remove foreign bodies from the larynx*, as in cases of membranous croup, laryngeal diphtheria, etc., the effort of vomiting being sometimes sufficient to dislodge and remove the membrane or other foreign substance.

4. *To remove the bronchial secretion* in cases of bronchitis and catarrhal pneumonia. In these cases the direct emetics should be

employed, preferably ipecacuanha or apomorphine, because they possess more expectorant properties.

5. *To empty the gall-bladder* in cases of biliousness or malaria, or where small gall-stones are present in the gall-duct, the compression of the liver between the diaphragm and the abdominal muscles expelling the bile from the liver into the duodenum and forcing the gall-stones through the duct.

6. *To relax spasm of the pharyngeal muscles* in cases of spasmodic laryngitis. For this purpose the systemic emetics are preferable.

Contraindications.—Emetics should not be given to persons suffering from aneurism, hernia, peritonitis, prolapse of the uterus or rectum, atheroma, or where there is very high arterial tension, a tendency to hemorrhage from the lungs or uterus, or a tendency to abortion.

The emetic drugs which have not been elsewhere discussed in the present work are here given in detail.

Apomorphīnæ Hydrochlōridum — Apomorphīnæ Hydrochlōridi—Apomorphine Hydrochloride. *U. S. P.*

Origin.—The hydrochloride of an alkaloid prepared from morphine by the abstraction of one molecule of water.

Description and Properties.—Minute, grayish-white, shining, acicular crystals, without odor, having a faintly bitter taste, and acquiring a greenish tint upon exposure to light and air. Soluble in about 39.5 parts of water and about 38.2 parts of alcohol. It should be kept in small, dark amber-colored vials. If the preparation imparts to 200 parts of water when slightly shaken an emerald-green color, the drug should be rejected.

Dose.—$\frac{1}{20}$–$\frac{1}{10}$ grain (0.003–0.006 Gm.) by the mouth; $\frac{1}{25}$–$\frac{1}{6}$ grain (0.0025–0.01 Gm.) hypodermically [$\frac{1}{30}$ grain as expectorant (0.002 Gm.); $\frac{1}{10}$ grain as an emetic (0.005 Gm.), U. S. P.].

Physiological Action.—*Externally and Locally.*—None.

Internally.—Digestive System.—From five to twenty minutes after ingestion—according to the dose and the manner of administration—vomiting ensues, being repeated three or four times at intervals of about fifteen minutes. The emesis is preceded and attended by a slight nausea, with but moderate depression. Apomorphine is a typical direct or systemic emetic, its entire action being exerted upon the medulla. It is perhaps the most powerful and certain emetic we possess. So far as its systemic action is concerned, its relation to morphine should be remembered.

Nervous System.—Full doses stimulate the brain and may even occasion delirium. Apomorphine frequently causes unconsciousness and may be used as a hypnotic, like morphine. Convulsions have been observed when given in large doses.

Circulatory System.—Small doses have no perceptible effect upon the circulation. Full doses increase the rapidity and force of the heart's action and raise arterial pressure, owing to stimulation of the

accelerator nerves and vasomotor center. Large or toxic amounts depress the circulatory system or paralyze the cardiac muscle.

Respiratory System.—Small amounts do not affect the respiratory movements, although the secretion from the bronchial mucous membrane is increased. Full doses accelerate and deepen respiration, while toxic amounts cause depression, as does morphine.

Absorption and Elimination.—Apomorphine is readily absorbed, and is excreted through the gastro-intestinal tract, as well as by the bronchopulmonary mucous membrane, the kidneys, and the skin.

Temperature is unaffected by small doses, but may be lowered by large amounts.

Poisoning.—The symptoms would be violent vomiting, delirium, or convulsions, and marked cardiac and respiratory depression, death resulting from asphyxia.

Treatment of Poisoning.—As that of morphine-poisoning.

Therapeutics.—Apomorphine is the most reliable emetic to use when prompt emesis is necessary or in cases where swallowing is difficult or impossible.

It is extremely useful as an emetic in cases of *poisoning*, though it frequently happens in narcotic poisoning that the vagus center is so blunted by the poison that apomorphine fails to act. Should it be necessary to provoke emesis when the stomach is in a state of acute inflammation, apomorphine is preferable to any other emetic.

Given by the mouth in small doses—from $\frac{1}{40}$ grain (0.001 Gm.) to $\frac{1}{20}$ grain (0.003 Gm.) every three or four hours—this drug is an exceedingly efficient remedy in *acute bronchitis.* It is equally beneficial in relieving the dry, hacking cough of *chronic bronchitis, chronic catarrhal pneumonia,* and *tuberculosis.*

Apomorphine in small doses has often proved a serviceable hypnotic.

Contraindications.—The same as for emetics generally. It is contraindicated in morphine-poisoning.

Administration.—Apomorphine when given as an emetic should invariably be administered hypodermically, and the solution be always freshly prepared. When the drug is used as an expectorant it should be given by the mouth. Great care should be taken in administering the drug to children, as they bear it badly.

Antimōnii et Potăssii Tărtras—Antimōnii et Potăssii Tartrātis—Antimony and Potassium Tartrate. *U. S. P.*

(Tartar Emetic; Tartrated Antimony.)

Origin.—Antimony trioxide is mixed with acid potassium tartrate and water to the consistence of a paste, allowed to stand for twenty-four hours, boiled in water, and crystallized.

Description and Properties.—Colorless, transparent crystals of the rhombic system, becoming opaque and white on exposure to air, or a white, granular powder, without odor and having a sweet, afterward disagreeable, metallic taste. Soluble in 15.5 parts of water and in 3 parts of boiling water, but insoluble in alcohol, which precipitates it from its aqueous solution in the form of a crystalline powder.

Dose.—1–2 grains (0.06–0.12 Gm.) as an emetic; ½–1 grain (0.03–0.06 Gm.) as a cardiac depressant; $\frac{1}{20}$–¼ grain (0.003–0.01 Gm.) as a diaphoretic and expectorant [$\frac{1}{10}$ grain (0.005 Gm.) as an expectorant; ½ grain (0.03 Gm.) as an emetic, U. S. P.].

Official Preparations.

Sȳrupus Scillæ Compŏsitus—Sȳrupi Scillæ Compŏsiti—Compound Syrup of Squills (HIVE SYRUP).—Formula: Fluidextract of squill, 80; fluidextract of senega, 80; antimony and potassium tartrate, 2; sugar, 750; purified talc, 20; water, to 1000.

Dose.—5–60 minims (0.3–4.0 Cc.).

Vīnum Antimōnii—Vīni Antimōnii—Wine of Antimony.—Formula: Antimony and potassium tartrate, 4; boiling distilled water, 65; alcohol, 175; white wine, to 1000.

Dose.—5–60 minims (0.3–4.0 Cc.) [15 minims (1 Cc.), U. S. P.].

Antagonists and Incompatibles.—Opium, alcohol, and the cardiac stimulants and antispasmodics generally are antagonistic. Tannic and gallic acids and the lead salts are incompatible.

Synergists.—Emetics, cathartics, and cardiac depressants promote the action of tartar emetic.

Physiological Action.—*Externally and Locally.*—Tartar emetic is a powerful irritant when applied to the skin, producing a follicular inflammation followed by a papular eruption, becoming vesicular, and later forming pustules with a central umbilication, desiccation finally occurring, the pustules closely resembling those of small-pox. Necrosis and ulceration may follow prolonged application.

Internally.—Digestive System.—Upon the mucous membrane of the gastro-intestinal tract, as upon the skin, antimony and potassium tartrate acts as a powerful irritant. Small doses, occasioning only a sensation of warmth in the stomach, soon produce an increased secretion of saliva and gastric juice, as well as of secretions from the intestines, liver, and pancreas, more or less nausea frequently accompanying these symptoms.

A little larger dosage excites vomiting, due to the irritating action of the drug upon the mucous membrane and nerves of the stomach. After absorption, it is thought that, antimony has a direct action on the medulla, causing vomiting, but the evidence is not conclusive. Full or large doses irritate the intestines, producing diarrhea, the discharges, if the dose has been excessive, being very loose and watery. Severe cramps and epigastric pains accompany the foregoing symptoms.

Circulatory System.—Tartar emetic is a powerful cardiac depressant, even in small doses slowing and weakening the heart's action, and simultaneously lowering arterial pressure by direct depression of the heart muscle.

Poisonous doses of the drug profoundly depress the heart, which is finally arrested in diastole.

Nervous System.—Antimony and potassium tartrate in small doses and under certain conditions exerts a sedative influence upon the brain. Indeed, its action is that of a depressant to the entire

nervous system, particularly the spinal cord, small doses depressing the sensory side, while poisonous doses depress both the motor and sensory centers of the cord. The intense prostration is probably a result of the circulatory depression acting on the nerve-centers rather than a direct nerve-cell involvement.

Under the administration of antimony, therefore, reflex excitability is diminished and the muscular system is depressed, the drug acting as an antispasmodic, probably by its influence both upon the muscles and the nervous system.

Respiratory System.—Very small doses have no effect upon the respiratory movements, but increase the secretions from the bronchial mucous membrane. Full doses depress the respiratory movements, shortening the inspiration but prolonging expiration. Toxic doses render the breathing extremely irregular and greatly lengthen the pause between inspiration and expiration, while there is an enormous increase in the bronchial secretion.

Absorption and Elimination.—Tartar emetic rapidly enters the blood, and is eliminated by many channels, principally by the bowels, but also by the bile, milk, sweat, and urine. The drug is an active diaphoretic, expectorant, and cholagogue.

Temperature.—Small doses do not affect temperature perceptibly; large doses lower bodily heat, chiefly by depressing the circulation.

Untoward Action.—The untoward manifestations produced by medicinal amounts of tartar emetic in individuals having a marked susceptibility to the drug do not differ essentially from the symptoms of poisoning next described.

Poisoning.—Tartar emetic produces all the symptoms of an irritant poison—severe burning sensation in the esophagus and stomach and violent and repeated vomiting, the ejecta, in addition to undigested food, containing mucus, bile, and frequently blood.

These symptoms are attended with severe colicky pains in the abdomen and serous purging, the discharges resembling those of cholera, the analogy with the latter disease being rendered the more striking by the presence of cramps in the extremities—a characteristic feature of poisoning by tartar emetic.

Together with these gastro-intestinal symptoms there is extreme prostration, accompanied by an irregular, weak, almost imperceptible pulse, great muscular relaxation, depressed respiration, pinched and livid countenance, cold, clammy skin, reduction of temperature, and scanty and bloody urine. Death may be preceded by stupor, wild delirium, or convulsions. Fatal dose of tartar emetic has been 2 grains (0.1 Gm.)—although much larger quantities have been taken. The prompt emesis has served to prevent poisoning.

Treatment of Poisoning.—If the poison has not been entirely ejected in the act of vomiting, the stomach should be immediately washed out with a solution of tannic acid, after which strong coffee should be administered, together with demulcent drinks, anodynes, and respiratory and cardiac stimulants should they be necessary.

Therapeutics.—*Externally and Locally.*—TARTAR EMETIC was formerly used as a rubefacient, being still so employed to some extent. The tendency of the drug, however, to produce extensive papular eruption and destruction of tissue renders its external use unsafe. Hebra considers that the external use of tartar emetic is a "useless, injurious procedure, and occasionally even dangerous to life."

Internally.—The medical uses of tartar emetic are constantly becoming more restricted. Because of its slow and depressing action the employment of the drug as an emetic has been practically abandoned. It is still used as a sedative in various *acute inflammations.* It is beneficial in the early stages of *acute laryngitis* and *bronchitis*, but its administration should be discontinued after a free secretion of bronchial mucus is established.

The remedy is given by many practitioners in the early stages of acute lobar pneumonia.

The COMPOUND SYRUP OF SQUILLS is a useful expectorant, being a popular and efficient remedy for spasmodic affections, particularly spasmodic laryngitis.

Administration.—As an emetic the action of the drug is facilitated and enhanced by associating it with ipecacuanha, the remedies together being given in powdered form.

As a diaphoretic and expectorant small doses of the wine of antimony are preferable, repeated every two or three hours.

Ipecacuănha—Ipecacuănhæ—Ipecac. *U. S. P.*

Definition.—The dried root, to which may be attached a portion of the stem, not more than 7 Cm. in length, of *Cephaëlis Ipecacuanha* (Brotero) A. Richard, known commercially as Rio, Brazilian, or Para Ipecac, or the corresponding portion of *C. acuminata* Karst, known commercially as Carthagena ipecac, yielding not less than 2 per cent. of ipecac alkaloids.

Description and Properties.—The older roots of Rio ipecac are in pieces of 2 to 6 inches (5–15 Cm.) in length and about ⅛ inch (4 Mm.) thick, mostly simple, contorted, dull grayish-brown or blackish, finely wrinkled, closely and irregularly annulated and often transversely fissured; bark thick, brittle, brownish, easily separated from the thin, whitish, tough, ligneous portion; odor slight, peculiar, nauseous; taste bitterish, acrid, nauseating. When ipecac is sound and free from mouldiness its quality is proportionate to the thickness of the bark and the thinness of the ligneous portion.

Carthagena ipecac is similar to Rio and about one-half thicker.

The active principles of ipecac are *emetine* and *cephaëline*, of the former of which there is present 1 to 2 per cent. The drug also contains ipecacuanhic or cephaëlic acid, starch, resin, etc.

Dose.—As an emetic, 15–30 grains (1.0–2.0 Gm.); as an expectorant, ½–2 grains (0.03–0.12 Gm.).

Official Preparations.

Fluidextrăctum Ipecacuănhæ—Fluidextrăcti Ipecacuănhæ—Fluidextract of Ipecacuanha.

Dose.—As an emetic, 15–30 minims (0.2–0.5 Cc.); as an expectorant, ½–2 minims (0.03–0.12 Cc.) [as an emetic, 15 minims (1 Cc.); as an expectorant, 1 minim (0.05 Cc.), U. S. P.].

Pŭlvis Ipecacuănhæ et Ōpii—Pulvĕris Ipecacuănhæ et Ōpii—Powder of Ipecac and Opium. (See *Opium.*)

Sȳrupus Ipecacuănhæ—Sȳrupi Ipecacuănhæ—Syrup of Ipecac.—Formula: Fluidextract of ipecac, 70; acetic acid, 10; glycerin, 100; sugar, 700; water, to 1000.

Dose.—As an emetic, 2.6 fluidrams (7.39–22.50 Cc.); as an expectorant, 5–30 minims (0.3–2.0 Cc.) [as an expectorant, 15 minims (1 Cc.); as an emetic, 4 fluid-drams (15 Cc.), U. S. P.].

Tinctūra Ipecacuănhæ et Ōpii—Tinctūræ Ipecacuănhæ et Ōpii—Tincture of Ipecac and Opium. (See *Opium.*)

Vīnum Ipecacuănhæ—Vīni Ipecacuănhæ – Wine of Ipecac (10 per cent.).—*Dose.*—1–60 minims (0.06–4.0 Cc.) [15 minims (1 Cc.), U. S. P.].

Antagonists and Incompatibles.—The gastric sedatives and narcotics generally hinder the emetic properties of ipecac. The incompatibles are tannic acid and vegetable infusions containing it, metallic salts, and caustic alkalies.

Synergists.—The emetics, sedative expectorants, warm drinks, are synergistic, and opium aids the diaphoretic properties of the drug.

Physiological Action.—*Externally and Locally.*—Ipecac is a powerful irritant to the mucous membranes of the respiratory tract when the powdered drug is inhaled. The prolonged application of ipecac to the skin occasions much irritation, even producing vesication, pustulation, and ulceration. Ipecac also possesses some antiseptic properties.

Internally.—Digestive System.—In small doses ipecac acts as a stimulant to the stomach. The salivary and gastric glands are stimulated, the action of very small doses of the drug resembling that of vegetable bitters.

Large doses are powerfully irritant and emetic, the emesis being the result of both a local irritation upon the stomach and perhaps some slight action on the vomiting center. The vomiting is preceded by and attended with but little, if any, nausea, although there is usually a marked increase in the secretion of bile and intestinal mucus, full doses of the drug acting not only as an emetic, but as a purgative and cholagogue.

Circulatory System.—Except in occasioning the ordinary depression incident to the act of vomiting, ipecac in moderate amounts has no influence upon the heart. Enormous doses, however, particularly if injected into the jugular vein, have destroyed the life of dogs by cardiac paralysis.

Nervous System.—Save in slight stimulation of the medulla oblongata and a slight diminution of the reflex activity of the spinal cord, ipecac has no important action upon the nervous system.

Respiratory System.—So far as the respiratory movements are concerned, they are unaffected by moderates doses of ipecac. The bronchial mucus membrane is stimulated, augmenting the secretion of bronchial mucus, and therefore reflexly stimulating coughing.

Absorption and Elimination.—The active principles of ipecac are rapidly absorbed, being eliminated chiefly by the gastro-intestinal

mucous membrane, although the other secretions share in the excretory process, the skin being especially affected by this drug, which acts as a mild diaphoretic.

Temperature.—Under medicinal doses the temperature is unchanged. Poisonous doses reduce temperature.

Untoward Action.—Rarely, in persons peculiarly susceptible to the drug, intense cutaneous irritation and conjunctival inflammation, accompanied by neuralgia of the face and scalp, have been produced. Even soiling the hand with a few drops of the tincture of ipecac has occasioned unfavorable results.

Poisoning.—There is violent vomiting and purging, the ejecta containing bile and frequently blood. Among the graver symptoms are abdominal pain, marked cardiac depression, muscular weakness, and greatly diminished reflex irritability. The skin is cold and bathed in perspiration.

Treatment of Poisoning.—Tannic acid should be given as the chemical antidote. Opium, belladonna, and cardiac stimulants may be necessary.

Therapeutics.—*Externally and Locally.*—TROCHES OF IPECAC and spray inhalations of WINE OF IPECAC are used to allay the cough and expectoration in acute *bronchitis* and obstinate "*winter cough.*"

Internally.—IPECAC in proper doses is a very efficient emetic, and is frequently employed as such, particularly when it is desirable through the act of vomiting to empty the air passages, as in *spasmodic laryngitis*, *bronchitis*, *tracheitis*, and the early stages of *diphtheria.* The action of the drug is so tardy, however, that it is not the most desirable emetic to use when it is necessary to empty the stomach quickly, as in cases of poisoning.

When the stomach contains a quantity of undigested food, causing pain, headache, etc., ipecac is a valuable emetic, since the drug occasions little marked nausea or depression.

Minute doses of IPECAC, such as 1 to 4 minims (0.06–0.2 Cc.) of the WINE or $\frac{1}{10}$ to $\frac{1}{4}$ grain (0.006–0.01 Gm.) of the POWDERED DRUG, act as an efficient gastric sedative and stomachic, frequently arresting *vomiting* when other drugs have failed. The statement, however, that minim doses of the wine of ipecac allay the nausea and vomiting of pregnancy is probably apocryphal.

IPECAC in small doses is an excellent adjuvant to other cholagogues to relieve the distress of *hepatic dyspepsia.* The drug is equally advantageous in *atonic dyspepsia*, attended with flatulence, depression of spirits, etc.

The notoriety and pecuniary profit which Helvetius secured in connection with ipecac—or *Radix antidysenterica*, as it was originally named by its propagator—were due to its apparent specific action in *dysentery.*

The drug is peculiarly efficient in dysentery. Whatever the form of dysenteric attack may be, ipecac is the more efficient the earlier it is administered.

The drug, in order to exert any beneficial influence in bilious

dysentery, must be given in large doses—60 to 90 grains (3.88–5.83 Gm.) in a single dose, or 20 grains (1.29 Gm.) every four hours. These doses, of course, will at first produce emesis, but the repetition of them tends to establish a tolerance of the remedy, an early attainment of which is most desirable.

Various methods have been employed to aid the stomach in retaining the drug, such as the administration of opium or other gastric sedative, a sinapism placed upon the epigastrium, etc.

Ipecac has been highly recommended in *infantile diarrhea*. It has been successfully employed in *hematemesis* and *uterine hemorrhage*, it being customary in the former complaint to give at first an emetic dose, succeeded by smaller and nauseating amounts.

Like other emetics, ipecac has proved efficient in expediting labor by relieving *rigidity of the os uteri*.

The drug has been found beneficial in relieving *hemoptysis*, and it is of unquestioned value in many affections of the lungs and bronchial tubes. In *pneumonia*, particularly in the congestive and declining stages of the disease, it has proved serviceable.

In *bronchitis* and *phthisis*, especially when the secretion is scanty, and in *chronic bronchitis* with much cough and but a moderate amount of expectoration, ipecac is a valuable remedy. It has been found valuable in *spasmodic asthma*.

Ipecac is an important adjuvant to quinine in the treatment of *remittent* and *intermittent fevers*, the latter disease having been cured, it is claimed, by ipecac alone in doses of 1 or 2 grains (0.06–0.12 Gm.), given every three or four hours.

Contraindications.—Ipecac is not permissible for patients suffering from aneurism, hernia, prolapse of uterus or rectum, etc.

Administration.—The drug is notoriously uncertain in its action, probably because of the variation in the percentage of emetine, the freshly powdered root being ordinarily more reliable.

As a diaphoretic the powder is also preferable, though in any case the fluidextract may be substituted for the powdered form. As an expectorant the syrup and wine are the preparations usually employed.

Children are very tolerant of ipecac, the syrup being the preparation usually given to them.

Emetine, represents the crude drug fully, and may be administered as an emetic in doses of $\frac{1}{12}$ to $\frac{1}{6}$ grain (0.005–0.01 Gm.), and in correspondingly small doses when a diaphoretic or expectorant action is desired. It has been found extremely difficult to prepare it free from other substances.

Lobēlia—Lobēliæ—Lobelia. *U. S. P.*

(INDIAN TOBACCO.)

Origin.—The dried leaves and tops of *Lobelia inflata* L., collected after a portion of the capsules have become inflated. The plant is indigenous in the United States.

Description and Properties.—As it appears in the market, lobelia consists

of fragments of green leaves, stems, rather elongated dried flowers, and portions of the membranous capsules. The odor is very irritating, and the taste pungent and persistently acrid. The plant contains a yellowish acrid liquid alkaloid, *lobeline*, besides *lobelic acid*, *lobelacrin*, resin, fixed oil, gum, etc.

Dose.—1–10 grains (0.065–0.6 Gm.) [7½ grains (5 Gm.), U. S. P.].

Official Preparations.

Fluidextrăctum Lobēliæ—Fluidextrăcti Lobēliæ—Fluidextract of Lobelia.—*Dose*, 1–10 minims (0.06–0.6 Cc.) [8 minims (0.5 Cc.), U. S. P.].

Tinctūra Lobēliæ—Tinctūræ Lobēliæ—Tincture of Lobelia (10 per cent.).—*Dose*, 8–15 minims (0.5–1.0 Cc.) [15 minims (1 Cc.) as expectorant; 1 fluidram (4 Cc.) as emetic, U. S. P.].

Antagonists and Incompatibles.—The effects of lobelia on the circulatory system are antagonized by the cardiac stimulants. The incompatibles are all caustic alkalies.

Synergists.—The motor depressants and emetics enhance the effect of lobelia.

Physiological Action.—*Externally and Locally.*—Although the drug is readily absorbed through the skin, there is no action of importance.

Internally.—Digestive System.—Lobelia produces symptoms similar to those of ipecac, save that lobelia is more powerful, occasioning more distressing nausea and intense prostration.

Circulatory System.—Lobelia is a powerful cardiac depressant, its action being due both to direct depression of the heart and paralysis of the vasomotor centers. Under poisonous doses the heart stops in diastole.

Nervous System.—Full doses depress the motor nerve-ganglia. Poisonous doses are necessary to affect the higher cerebral centers, when coma and convulsions are produced. The muscles and nerves themselves are unaffected by lobelia.

Respiratory System.—The muscular coats of the bronchi are relaxed by the drug. The respiration is slowed even by small doses. Large or toxic doses profoundly depress the respiratory center, death resulting from respiratory failure.

Absorption and Elimination.—The active principle of lobelia is readily absorbed, and is excreted chiefly by the kidneys and skin, the drug acting as a diuretic and diaphoretic. Under emetic doses much of the drug is eliminated by way of the stomach and intestines.

Temperature.—Full doses lower the temperature.

Untoward Action.—Does not differ essentially from the effects of poisoning.

Poisoning.—The symptoms include—violent vomiting and purging, a very weak and irregular pulse, an anxious, livid countenance, skin cold and bathed in perspiration, respiration slow and very feeble, contracted pupils, and possibly coma or convulsions preceding death, which occurs from respiratory failure.

Treatment of Poisoning.—The symptoms should be counter-

acted by cardiac and respiratory stimulants, employing such drugs as atropine, strychnine, alcohol, ammonia, etc., hypodermically.

Therapeutics.—*Externally and Locally.*—None.

Internally.—While formerly lobelia was used extensively as an emetic, at the present day, owing to the intense nausea and great depression occasioned by the drug, it has been practically supplanted by other less dangerous emetics.

Its principal use nowadays is as a remedy in *spasmodic asthma* and as an expectorant in certain cases of *bronchitis.*

Contraindications.—The same as for emetics in general.

Administration.—The powder, fluidextract, or tincture may be used.

CATHARTICS.

Cathartics or Purgatives are substances which cause evacuation of the bowels either by direct local irritation of the intestinal mucous membrane or by setting up an osmotic current from the tissues toward the lumen of the intestines, causing an accumulation of fluid in the bowels—in both cases causing increased peristalsis and watery or semisolid evacuations.

Mechanism of Purgation.—It should be remembered that the epithelial surfaces through which the substances needful to the body enter it, and the waste-products leave it, are physiologically outside the body. The mucous membrane of the alimentary canal is in a sense as much external as the skin covering the surface of the body and is subject to the same irritating influences. The muscular mechanism of the intestines is somewhat peculiar in that it possesses the power to rhythmically contract and relax in a wave-like manner (peristalsis), the peristaltic wave traveling downward. These rhythmical movements of the intestines carry their contents along their lumen from the cardia to the rectum, and are to a large extent independent of the central nervous system, although controlled by nervous mechanisms. The normal contents of the small intestine are fluid, and are passed into the large intestine as such. In their passage along the large bowel the fluid part is largely absorbed and the semisolid part remaining is passed on into the rectum as feces.

In order that any substance may act as a purgative it must change the normal contents of the bowels in such a way as to cause fluid or semisolid evacuations. When a substance locally irritates the intestinal mucous membrane the intestines respond by increased peristalsis, which hurries the fluid contents of the small intestine through the large bowel so rapidly that absorption does not take place and the feces are evacuated in a fluid form.

Cathartics may be classified according to their various actions, the following table serving to show how and where the various drugs exert their several influences:

1. Classification according to their Mode of Action.

Laxatives.	Simple purgatives.	Hydragogue purgatives.	Drastic purgatives.
Cassia.	Aloes.	Croton oil (small doses).	Cathartic acid (hypodermically).
Castor oil.	Calomel.*	Elaterin.	Colocynth.
Cascara sagrada.	Cascara sagrada (full doses).	Gamboge.	Croton oil.
* Glycerin.	Castor oil (full doses).		Elaterin.
* Magnesia.	Ox-gall.	**Salines.**	Gamboge.
* Magnesium carbonate.	Rhubarb.	Magnesium citrate.	Jalap.
Manna.	Euonymus.	Magnesium sulphate.	Scammony.
Sulphur.	Iris.	Potassium bitartrate.*	Podophyllin.
Taraxacum.	Juglans.	Potassium sulphate.	
There are certain drugs which are not classed as cathartics, which are sometimes prescribed by physicians as laxatives, such as—	Leptandra.	Potassium tartrate.*	
Belladonna.*	Senna.	Potassium and sodium tartrate.	
Ergot.*		Sodium phosphate.	
Hyoscyamus.*		Sodium sulphate.	
Nux vomica.*			
Physostigma.*			
Stramonium.*			
Certain articles of diet are laxative, such as bran biscuit, brown bread, gingerbread, oatmeal, figs, honey, molasses, prunes, raspberries, strawberries, tamarinds, olive oil, etc.			

2. Classification according to their Manner of reaching the Intestinal Mechanism.

By first contact.	By circulation contact.	By excretion contact.
Nearly all the drugs used as cathartics.	Morphine.*	Aloes.
	Muscarine.*	Castor oil.
	Physostigma.*	Croton oil.
	Pilocarpine.*	Colocynth.
	Strychnine.*	Elaterium.
		Podophyllin.
		Rhubarb.
		Senna.

3. Conditions of the Intestines affecting the Action of Drugs.

Drugs requiring the presence of an alkali or bile to act.	Drugs requiring the presence of an acid to act.	Drugs not requiring the presence of either alkali, bile, or acid.
Aloes.	Magnesium carbonate.*	Castor oil.
Elaterium.	Magnesia.*	Colocynth.
Gamboge.		Croton oil.
Jalap.		Euonymin.
Scammony.		Iris.
Sulphur.		Leptandra.
		Magnesium citrate.
		Magnesium sulphate.
		Podophyllin.
		Potassium and sodium tartrate.
		Rhubarb.
		Senna.
		Sodium phosphate.

(Drugs marked with an asterisk (*) are here given in detail; others are described elsewhere.)

4. *Classification according to the Anatomical Portion of the Intestinal Canal on which they Act.*

Small intestine.	Colon.	Descending colon and rectum.
Calomel.*	Colocynth.	Aloes.
Castor oil.	Elaterium.	
Jalap.	Gamboge.	
Leptandra.	Magnesium citrate.	
Podophyllin.	Magnesium sulphate.	
Rhubarb.	Potassium bitartrate.*	
Scammony.	Potassium sulphate.	
Senna.	Potassium tartrate.*	
	Potassium and sodium tartrate.	
	Sodium sulphate.	

5. *Classification of Cathartics according to Other Actions.*

Stomachics.	Hepatic stimulants and cholagogues.	Galactogogues.	Rendering the milk purgative.	Increasing menstrual flow.
Aloes.	Aloes.	Castor oil.	Aloes.	Aloes.
Cascara sagrada.	Colocynth.		Castor oil.	
Euonymin.	Colchicin.		Rhubarb.	
Leptandrin.	Euonymin.		Senna.	
Iridin.	Iridin.		There are probably some other cathartics that affect the milk.	
Rhubarb.	Leptandrin.			
	Podophyllin.			
	Sodium phosphate.			
	Sodium sulphate.			

Cholagogues.

Aloes.	Mercury with chalk.*
Calomel.*	Pil. hydrargyri.*
Colocynth.	Podophyllin.
Euonymin.	Rhubarb.
Iridin.	

(Drugs marked with an asterisk (*) are here given in detail; others are described elsewhere.)

Intestinal peristalsis is increased probably by:

Stimulation of:

1. The intestinal muscles (moderate stimulation);
2. The afferent nerves connecting the intestinal mucous membrane with Auerbach's ganglia;
3. Auerbach's ganglia;
4. The ends of the efferent nerves passing from Auerbach's ganglia to the intestinal muscles;
5. The ends of the afferent nerves passing from the intestinal mucous membrane to the brain;
6. The motor centers in the brain;
7. The ends of the motor nerves terminating in Auerbach's ganglia.

Depression of:

8. The inhibitory motor center;
9. The ends of the inhibitory motor nerves terminating in Auerbach's ganglia;
10. The inhibitory motor center in the suprarenal plexus.

It will be seen that any substance which stimulates the motor apparatus or depresses the inhibitory motor mechanism will increase peristalsis.

Intestinal secretion may doubtless be promoted by any substance which serves to stimulate the secretory or the vasodilator apparatus, or to depress the inhibitory secretory or vasoconstrictor mechanism.

The methods by which absorption is diminished are not thoroughly understood, but it is known that:

1. By increasing peristalsis and hastening the removal of fluid from the bowels absorption takes place less rapidly;
2. By giving drugs—*e. g.*, magnesium sulphate—having high osmotic equivalents, with a great affinity for water, the absorption of fluid is prevented;
3. Substances which in some manner affect the columnar epithelium of the intestinal glands retard absorption;
4. Drugs which diminish the circulation in the intestinal mucous membranes act as deterrents to the absorptive process.

It is apparent that certain drugs produce various effects, and that their mode of action varies according to the size of the dose and occasionally with the idiosyncrasy of the patient.

Nearly all cathartic drugs act by some local influence upon the intestinal mucous membranes previous to absorption; others, again, affect the bowels after they have entered the circulation—strychnine, for example, physostigmine, pilocarpine, etc., acting in this manner.

Certain other drugs, such as podophyllin, colocynth, etc., if injected into the circulation, are excreted by the mucous membrane of the intestines, and by their irritation produce catharsis.

The condition of the intestinal canal has much to do with the activity of certain drugs. Thus, certain medicines produce catharsis regardless of the reaction of intestinal fluids; others are inert without the presence of bile or other alkaline fluids or salts; and still a third class occasion catharsis only when after ingestion they come in contact with an acid. Of the last-mentioned, magnesium carbonate is an excellent example, the drug being inert unless it be acted upon by an acid in the stomach or bowels.

It is an interesting fact that, as shown by experience, different cathartics may act more energetically upon different portions of the intestines. The action of calomel, for instance, is almost entirely confined to the duodenum, while aloes acts largely upon the descending colon and the rectum.

In selecting a cathartic, therefore, a knowledge of the part of the intestinal canal to be acted upon and the locality in which the drug operates is necessary in order to secure the most satisfactory results.

Many cathartics contain principles which render them tonic to the stomach; some few are thought to directly stimulate the hepatic cells—mercury preparations; while the cholagogues merely

hasten the expulsion of the bile from the intestinal canal, preventing its absorption.

Certain drugs, being excreted in the milk, which it renders purgative, are well adapted for administration to the nursing mother in order to produce catharsis in the infant. Castor oil, greatly augmenting the secretion of milk, is an excellent medium as a laxative in such cases.

Aloes increases the menstrual flow; other drugs promote the secretion of urine, etc.

Therapeutics.—Cathartics are employed:

To remove feces and produce a simple evacuation of the bowels. The laxatives are best adapted for this purpose.

For the relief of chronic constipation. For this purpose great judgment is requisite in the selection of a drug or combination of agents, it being important to determine whether there is diminished peristalsis or secretion; whether there exists an atonic condition of the intestinal muscles; or whether the disorder is located in the small intestine, the colon, or the rectum.

To remove from the bowels noxious substances or pathogenic matter. For this purpose the mercurial preparations, calomel or gray powder, are best, since they are not only active cathartics, but bactericides as well.

To stimulate the torpid liver. For this purpose the hepatic stimulants would naturally be employed.

To lessen the activity of the liver, as in bilious conditions. In such cases the cholagogue cathartics should be used.

To deplete the gastroduodenal mucous membrane, where the congested and swollen mucous membrane obstructs the outflow of bile, resulting in jaundice. In this condition the salines, especially the sodium salts, are the most efficient cathartics.

To promote absorption and remove dropsical effusions in certain diseases of the heart, liver, and kidneys. Here active catharsis is necessary, the hydragogue cathartics being indicated.

To remove urea, etc., from the blood. Occasionally in certain renal diseases the functional activity of the kidneys is so defective that waste-matter, urea, etc., rapidly accumulates in the body, occasioning uremic convulsions, coma, or other serious symptoms. In such cases it may be necessary to give a drastic purgative, such as croton oil, which acts rapidly, causing profuse watery stools.

To lower the blood-pressure where high arterial tension aggravates a malady, as at the onset of many acute diseases, and in cerebral hemorrhage, meningitis, etc. In these conditions it is necessary to employ such drugs which, by dilating the intestinal blood-vessels, drain the blood away from other organs and cause abundant watery discharges from the bowels. Hydragogue or drastic purgatives answer the required purpose.

For the relief of hemorrhoids, in which cases the mild laxatives, such as sulphur, senna, etc., are serviceable.

To aid the restoration of the catamenia. For this purpose aloes

is usually employed, particularly if it be necessary to determine more blood to the pelvic organs. If depletion be required, the selection should be made from the hydragogue cathartics.

To purge the nursing infant through the mother's milk. For this purpose such drugs as rhubarb, senna, and castor oil may be administered to the mother.

To lower the temperature in fever, in which cases the saline cathartics may be advantageously employed.

Contraindications.—Active catharsis by the more powerful hydragogue or drastic purgatives would be contraindicated in appendicitis, peritonitis, typhlitis, intussusception, pregnancy, and typhoid fever, or where there is inflammation of the mucous membrane of the gastro-intestinal tract.

Administration.—Probably no group of medicines demands greater judgment in the administration than cathartics.

Ordinarily, the efficiency of these agents is increased and their operation rendered less irritant by associating drugs acting upon different portions of the alimentary canal. Their action, too, is more prompt and certain when the remedies are given upon an empty stomach and the efficiency of their operation is enhanced by exercise and diminished by sleep.

The action of cathartics is promoted by the addition of small doses of emetics, mydriatics, quinine, and bitters, quinine especially strengthening the action of magnesium sulphate. Mild diluent beverages also promote the activity of cathartics. Cold applied to the abdomen, enemata, massage of the abdominal walls, and electricity, all act as adjuvant measures in the employment of purgative medicines.

As has been previously suggested, a knowledge of the portion of the intestinal canal upon which the various cathartics act is of primary importance. Thus, if it be necessary to influence only the duodenum, calomel or podophyllum should be used; if the small intestine, senna or jalap; if the descending colon or rectum, aloes—these drugs acting chiefly upon these organs.

Moreover, due consideration should be given to the proper time for the administration of the different cathartics, the resinoid purgatives acting best when taken at night or before dinner, and the salines when taken in the morning before breakfast.

The mode of administration is also of great importance, in order to obtain from these agents the fullest benefit. The salines, for instance, act best when given in solution in either very cold or very hot water, their activity being enhanced by association with bitters, iron, or sulphuric acid. On the other hand, the resinoid drugs should be administered in the form of pills, and if, for any reason, it is desirable that the drug should enter the intestine without coming in contact with the mucous membrane of the stomach, the drug may be given in the form of pills coated with keratin, which is unaffected by the gastric juice, but readily dissolved in the alkaline intestinal juices.

In the following detailed description cathartic drugs are grouped according to their *modus operandi*, the mildest drugs or laxatives being first considered.

LAXATIVES.

Certain substances never produce active purgation, but simply unload the bowels by slightly increasing both peristalsis and secretion, expelling the feces in a softened, though solid and formed, condition, without irritation and without perceptibly affecting the general system.

These agents are especially useful where we wish to evacuate the bowels with the least possible local derangement, as in simple constipation from dyspepsia, in children, pregnant women, convalescents from acute disease, or patients affected with hemorrhoids, hernia, affections of the rectum or womb, typhoid fever, early simple diarrhea, or in inflammation or surgical operations about the abdomen and pelvis.

In addition to the laxative drugs here mentioned there are many articles of diet which by purely mechanical action produce catharsis, such as oatmeal, brown bread, whole flour, molasses, prunes, figs, onions, spinach, celery, lettuce, etc.

Căssia Fīstula—Căssiæ Fīstulæ—Cassia Fistula. *U. S. P.*

(PURGING CASSIA.)

Origin.—The dried fruit of *Cassia Fistula* L., a tree 30 to 50 feet (9–15 M.) high, indigenous in the East Indies.

Description and Properties.—Cylindrical, 1½ to 2 feet (45–60 Cm.) long, nearly 1 inch (25 Mm.) in diameter, blackish brown, somewhat veined, the sutures smooth, forming two longitudinal bands; indehiscent, internally divided transversely into numerous cells, each containing a reddish-brown, glossy, flattish-ovate seed imbedded in a blackish-brown sugary pulp; odor resembling that of prunes.

Dose.—1–2 drams (4.0–8.0 Gm.) [1 dram (4 Gm.), U. S. P.].

Official Preparation.

Confĕctio Sĕnnæ—Confectiōnis Sĕnnæ—Confection of Senna.—Described under *Senna*.

Physiological Action and Therapeutics.—Cassia is a mild and pleasant laxative. It is seldom given alone, however, but forms an ingredient in the confection of senna.

Ōleum Ricīni—Ōlei Ricīni—Castor Oil. *U. S. P.*

Origin.—A fixed oil compressed from the seed of *Ricinus communis* L., a plant indigenous in Southern Asia and cultivated in temperate countries for ornament and other purposes, remaining a large annual.

Description and Properties.—A pale-yellowish or almost colorless, transparent, viscid liquid, having a faint, mild odor and a bland, afterward slightly acrid and generally offensive taste. Soluble in an equal volume of alcohol and all proportions in absolute alcohol. Castor oil should be kept in well-stoppered bottles.

Dose.—¼–2 fluidounces (8.0–60.0 Cc.) [4 fluidrams (16 Cc.), U. S. P.].

Physiological Action.—*Externally and Locally.*—Castor oil—like other bland fixed oils, such as almond oil, olive oil, etc.—is sedative and protective when applied to the skin or mucous membranes.

Internally.—The only important action is upon the intestinal tract, on which the oil acts as a mild irritant, causing purgation. Chemically castor oil is a combination of glycerin, fatty acids, and ricinoleic acid. This combination goes through the stomach unchanged, but in the presence of the bile and pancreatic juice it is broken up into glycerin and ricinoleic acid; the ricinoleic acid combines with sodium and forms sodium ricinoleate, which has marked irritating properties. The ricinoleate of sodium is absorbed and excreted in various ways, appearing in the mother's milk and imparting to it purgative properties.

Castor oil requires from four to six hours to operate, its action being usually attended with little pain. It causes a large, soft stool and usually empties the entire intestinal canal.

The poisonous principle, ricin, found in the seed-coat of castor oil beans, is an albuminous substance belonging to the globulin group, and is generally termed a toxglobulin. Ricin is one of the most powerful poisons known, but being insoluble in oil and soluble in water it is not present in expressed castor oil. The symptoms of poisoning from castor beans are violent abdominal pain, vomiting, purging, and collapse. *Postmortem* examinations have revealed evidences of severe inflammation in the stomach and intestines, with capillary thrombi in various organs.

Castor oil should not be used as an habitual laxative, its continual employment being liable to occasion constipation with all its attendant evils.

Therapeutics.—Castor oil is used alone or associated with balsam of Peru as a sedative protectant dressing for *superficial ulcerations.* The drug is also serviceable in various diseases of the skin and mouth.

It is probably superior to all other laxatives, and is applicable to all conditions for which laxatives are employed. In large doses it is one of the best purgatives to give in conjunction with an anthelmintic.

Administration.—The unpleasant taste of castor oil is the only objection to its use. Yet it can be rendered quite palatable by mixing it with a small quantity of glycerin, to which may be added a few drops of oil of cinnamon or oil of wintergreen.

Various other devices for disguising the taste have been adopted, such as enveloping the oil in the froth of beer, ale, or porter, or washing out the mouth with brandy or whisky previous to administration, and allowing the patient to swallow the oil quickly, when it will not adhere to the mouth and fauces, especially if followed by a drink of some alcoholic liquid.

In the form of an emulsion the taste of the oil is well disguised. There are also soft capsules of castor oil which are, of course, tasteless, yet they are too bulky to be popular.

Castor-oil emulsion may be used as an enema when a mild injection is required.

Rhămnus Purshiāna—Rhămni Purshiānæ—Cascara Sagrada. *U. S. P.*

Origin.—The dried bark of *Rhamnus Purshiana* D. C., collected at least one year before being used. Rhamnus Purshiana is a shrub or small tree 15 to 20 feet (4.5–6 M.) high, indigenous on the Pacific coast of North America from the British possessions southward to Northern California.

Description and Properties.—Quills or curved pieces about ¼ to 4 inches (3–10 Cm.) long and about $\frac{1}{12}$ inch (2 Mm.) thick; outer surface brownish gray and whitish, the young bark with numerous, rather broad, pale-colored warts; inner surface yellowish to light-brownish, becoming dark-brown with age; smooth or finely striate, fracture short, yellowish, in the inner layer of thick bark somewhat fibrous; inodorous; taste bitter.

The bark contains red, yellow, and brown resins, containing anthraquinone derivatives—anthracenes—tannic, malic, and oxalic acids, a volatile oil, and possibly a glycoside, xantho-rhamnin or purshianin.

Dose.—30–60 grains (2.0–4.0 Gm.) [15 grains (1 Gm.), U. S. P.].

Official Preparations.

Fluidextrăctum Rhămni Purshiānæ Aromăticum—Fluidextrăcti Rhămni Purshiānæ Aromătici—Aromatic Fluidextract of Cascara Sagrada (U. S. P.).—This is the aromatic fluidextract of cascara sagrada of the National Formulary. It differs from the fluidextract, which was already official, in having an aromatic flavor and being devoid of the intensely bitter principle occurring in the bark.

Dose.—Average dose: 15 minims (1 Cc.), U. S. P.

Extrăctum Rhămni Purshiānæ—Extrăcti Rhămni Purshiānæ—Extract of Cascara Sagrada (U. S. P.).—One part of the solid extract represents the activity of four parts by weight of the bark.

Dose.—Average dose: 4 grains (0.250 Gm. = 250 milligrammes), U. S. P.

[This represents 15 grains (1 Gm.) of the bark, and is equal to the Pharmacopœial dose of the fluidextract—namely, 15 minims (1 Cc.).]

Physiological Action.—Cascara sagrada is a peculiarly efficient laxative, although in certain individuals it appears to be inert unless associated with other purgatives. The bitter principle it contains gives to the drug stomachic properties.

The action of cascara is seldom attended with irritation or unpleasant symptoms, the drug requiring from six to ten hours to operate.

Therapeutics.—Cascara is a very valuable laxative, being employed chiefly to overcome *habitual constipation* due to simple torpor of the colon without associated disease. The drug is not adapted for rapid evacuation of the bowels, but rather for regulating their action.

Administration.—The fluid and solid extracts are usually employed, although the cascara cordial and the aromatic fluidextract, while requiring larger doses, are so palatable that they have become deservedly popular.

Whatever be the preparation used in cases of habitual constipation, it should be given in small but repeated doses, gradually diminished until a natural action of the bowels shall have been

established. The drug should be administered upon an empty stomach and in as diluted a condition as possible.

Magnēsii Ŏxidum—Magnēsii Ŏxidi—Magnesium Oxidum. *U. S. P.*

(LIGHT MAGNESIA; CALCINED MAGNESIA.)

Origin, Description, and Properties given under *Alkalies*.
Dose.—5–60 grains (0.32–4.0 Gm.) [30 grains (2 Gm.), U. S. P.].

Magnēsii Carbōnas—Magnēsii Carbonātis—Magnesium Carbonate. *U. S. P.*

Origin, Description, and Properties given under *Alkalies*.
Dose.—¼–2 drams (1.0–8.0 Gm.) [45 grains (3 Gm.), U. S. P.].

Physiological Action.—Both magnesia and magnesium carbonate are mild antacid laxatives, requiring the presence of an acid in the stomach and bowels to render them active. Occasionally, when there is marked acidity of the stomach, magnesium carbonate occasions flatulence.

When taken in large amounts or for a long time magnesia tends to accumulate in the intestines. This untoward effect may be prevented by administering lemonade with the drug, the acid of which increases the solubility of the magnesia.

Therapeutics.—MAGNESIUM CARBONATE as a protective powder is an effective agent in the treatment of *dermatitis of the external auditory passage*. The drug is a valuable antidote to counteract the effects of *phosphorus-poisoning* in the throat.

Both MAGNESIA and MAGNESIUM CARBONATE are mild alkalies, and may be used for the same purposes as the alkalies. They are serviceable antidotes to *poisoning* from mineral and oxalic acids and many mineral salts. They are pleasant laxatives, being extensively employed for children.

Mănna—Mănnæ—Manna. *U. S. P.*

Origin.—The concrete, saccharine exudation of *Fraxinus Ornus* L., a slender tree indigenous on the northern shore of the Mediterranean from Asia Minor west to Spain.

Description and Properties.—Flattish, somewhat three edged pieces, about 8 inches (20 Cm.) long and 2 inches (5 Cm.) broad (usually smaller), friable, externally yellowish-white, internally white, porous, and crystalline; or fragments of different sizes, brownish-white, and somewhat glutinous on the surface, internally white and crystalline; odor honey-like; taste sweet, slightly bitter, and faintly acrid. Manna contains a resin, the purgative principle, besides mannite, fraxin, and sugar.

Dose.—½–1 ounce (16.0–32.0 Gm.) [½ ounce (16 Gm.), U. S. P.], dissolved in hot water.

Official Preparation.

Infŭsum Sĕnnæ Compŏsitum—Infŭsi Sĕnnæ Compŏsiti—Compound Infusion of Senna.—See *Senna*.

Physiological Action and Therapeutics.—Manna is a laxative, cholagogue, and nutrient. Its mild laxative action renders the

drug peculiarly efficient in *constipated conditions* of pregnant women, and children and persons suffering from *piles* or *irritation of the genito-urinary tract.*

The drug is slow in its action, tending to confine the bowels after the primary laxative effect.

Sŭlphur Sublimātum—Sulphūris Sublimāti—Sublimed Sulphur. *U. S. P.*

Origin.—Obtained from crude sulphur by sublimation.

Description and Properties.—A fine yellow powder, having a slight characteristic odor and a faintly acid taste. Insoluble in water; slightly soluble in absolute alcohol; more readily soluble in benzin, benzol, oil of turpentine, and many other oils, as well as in ether, chloroform, and boiling aqueous solutions of alkaline hydrates.

Dose.—15–60 grains (1.0–4.0 Gm.) [60 grains (4 Gm.), U. S. P.].

Official Preparations.

Sŭlphur Lōtum—Sulphūris Lōti—Washed Sulphur.—*Origin.*—Sublimed sulphur, 100; water, q. s.; ammonia water, 10; digested, filtered, drained, and dried.

Description and Properties.—A fine yellow powder, without odor or taste. Insoluble in water, but soluble in the substances which dissolve sulphur.

Dose.—15–60 grains (1.0–4.0 Gm.) [60 grains (4 Gm.), U. S. P.].

Unguĕntum Sŭlphuris—Unguĕnti Sŭlphuris—Sulphur Ointment.—Washed sulphur, 150; benzoinated lard, 850. For external use.

Washed sulphur is an ingredient of compound liquorice powder.

Sŭlphur Præcipitātum—Sŭlphuris Præcipitāti—Precipitated Sulphur (MILK OF SULPHUR; LAC SULPHUR).—*Origin.*—Sublimed sulphur is boiled with slaked lime and water. To the solution is added hydrochloric acid, which throws down sulphur as a fine precipitate, the powder being washed and dried.

Description and Properties.—A fine amorphous powder of a pale-yellow color, without odor or taste. Insoluble in water.

Dose.—15–60 grains (1.0–4.0 Gm.) [60 grains (4 Gm.), U. S. P.].

Physiological Action.—*Externally and Locally.*—Sulphur is an active parasiticide, antiseptic, and keratoplastic agent. Upon the skin the drug of itself has no influence; a portion of it, however, is converted into hydrogen sulphide, which acts as a mild cutaneous irritant.

Internally.—As observed, sulphur proper has no action either externally or locally, although it is a normal constituent of nearly all the solids and fluids of the body. When ingested some of it is converted into hydrogen sulphide and other sulphides, which increase the intestinal secretions and promote peristalsis.

The drug is chiefly excreted with the stools, which are rendered soft and semiliquid. A portion of the hydrogen sulphide formed is eliminated through the kidneys, lungs, skin, and milk-glands. The drug is usually found in the urine as a sulphate.

There is imparted to the breath the offensive odor of hydrogen sulphide, and the minute portion eliminated through the skin is sufficient to discolor silver ornaments in contact with the surface of the body.

While hydrogen sulphide is a powerful poison, decomposing the blood and paralyzing the nervous and muscular systems, the

amount formed and absorbed under the administration of sulphur is too small to produce marked toxic symptoms. Even when large amounts of sulphur have been ingested, there is produced only violent vomiting and purging, a slight elevation of temperature, and a distinct odor of hydrogen sulphide in the breath.

When sulphur is used in full doses for a long time, it tends to impair the quality of the blood and produce muscular weakness. Occasionally untoward manifestations, such as miliary eruptions and eczema, accompany either the external application or the ingestion of the drug.

As a laxative sulphur is slow and mild, although it occasionally causes considerable flatus, in some cases rendering the drug objectionable as a purgative.

Therapeutics.—*Externally and Locally.*—While classed among laxative drugs, SULPHUR is a most efficient remedy in many diseases of the *skin*, *nose*, *throat*, etc., the external uses of sulphur being very numerous.

The drug is perhaps the most serviceable parasiticide we possess in *scabies*, SULPHUR OINTMENT well rubbed into the skin being usually sufficient to destroy the parasite.

Even diseases induced by vegetable parasites, such as *tinea versicolor*, etc., are cured by inunctions of SULPHUR OINTMENT.

The drug is successfully employed in the treatment of *infiltrated eczema*, *impetigo*, *sycosis*, *ecthyma*, *acne*, *comedo*, and *psoriasis*.

The FLOWERS OF SULPHUR is an old domestic remedy, and quite an efficient one, in *diphtheria* and *pharyngitis*. Finally, Coroden and Duchane have both reported the successful treatment of *sciatica* by enveloping the affected limb in PRECIPITATED SULPHUR, the profuse sweating induced being followed by a decided alleviation of pain.

When SULPHUR is burned in moist air sulphur dioxide is formed, which, if large quantities are confined in a small space and added to moist steam, is a fair disinfectant. It is probable that the old-fashioned methods of sulphur fumigation are little short of being farcical.

Internally.—The principal internal use of SULPHUR is as a mild laxative, the drug being especially indicated for persons afflicted with *hemorrhoids* or *anal fissure*.

LOZENGES are prepared containing sulphur and cream of tartar, which, if taken daily for some time, will overcome *habitual constipation*.

SULPHUR has been used internally, and occasionally with considerable success, in *bronchitis*, *chronic rheumatism*, and *eczema* attended with much itching.

Administration.—Sulphur may be given in the form of lozenges or mixed with molasses—either alone or associated with cream of tartar, which is said to enhance the action of sulphur. Milk and syrup have been used as vehicles in the administration of the drug.

Sulphurous baths, both natural and artificial, have been employed in the treatment of *rheumatism*, *gout*, and some *cutaneous affections*. Not only for these purposes, but for their laxative influence as well, sulphurous waters are held in great repute.

Taraxăcum—Tarăxaci—Taraxacum. *U. S. P.*

(DANDELION.)

Origin.—The dried root of *Taraxacum officinale* Weber, a perennial, acaulescent herb found in most countries of the northern hemisphere.

Description and Properties.—Slightly conical, about 12 inches (30 Cm.) long and ½ to 1 inch (12–25 Mm.) thick above, crowned with several short, thickish heads, somewhat branched, dark-brown, longitudinally wrinkled; when dry breaking with a short fracture, showing a yellowish, porous central axis surrounded by a thick white bark containing numerous milk-vessels arranged in concentric circles; inodorous; bitter.

The drug contains a bitter principle, *taraxacin*, besides *inulin*, resin, sugar, and mucilaginous substances.

Dose.—1–4 drams (4.0–15.0 Gm.) [2 drams (8 Gm.), U. S. P.].

Official Preparations.

Extrăctum Tarăxaci—Extrăcti Tarăxaci—Extract of Taraxacum.—*Dose*, 5–60 grains (0.3–4.0 Gm.) [15 grains (1 Gm.), U. S. P.].

Fluidextrăctum Tarăxaci—Fluidextrăcti Tarăxaci—Fluidextract of Taraxacum.—*Dose*, 1–4 fluidrams (4.0–15.0 Cc.) [2 fluidrams (8 Cc.), U. S. P.].

Physiological Action and Therapeutics.—Taraxacum is a stomachic tonic, diuretic, laxative, cholagogue, and feeble hepatic stimulant. It has been a popular remedy for *constipation* associated with *hepatic congestion* and *atonic dyspepsia*, yet the drug is now less employed than formerly, in actual practice being usually united with other laxatives.

The extract or fluidextract may be given, the latter and the expressed juice being the more active.

SIMPLE PURGATIVES.

These differ from laxatives only in degree, the former being more active, exciting greater peristaltic action and causing a larger secretion from the intestinal glands. Simple purgatives usually occasion one or more copious and somewhat liquid stools, frequently accompanied by considerable irritation and griping.

Ăloe—Ăloes—Aloes. *U. S. P.*

Origin.—The inspissated juice of the leaves of *Aloe vera* (L.) Webb; *Aloe Perryi* Baker, *Aloe Chinensis* Baker, or other species of *Aloe*, plants resembling the so-called century plant (*Agave Americana*), indigenous in India and Northeastern Africa, and naturalized along the shores of the Mediterranean and the West Indies.

Dose.—½–10 grains (0.03–0.6 Gm.).

Official Preparations.

Extrāctum Āloes—Extrācti Āloes—Extract of Aloes.—*Dose*, ½–6 grains (0.03–0.4 Gm.) [2 grains (0.125 Gm.), U. S. P.].

Āloe Purificāta—Āloes Purificātæ—Purified Aloes.—*Dose*, ½–10 grains (0.03–0.6 Gm.) [4 grains (0.25 Gm.), U. S. P.].

Pĭlulæ Āloes—Pĭlulas (acc.) **Āloes—Pills of Aloes.**—*Dose*, 1 to 4 pills.

Pĭlulæ Āloes et Fĕrri—Pĭlulas (acc.) **Āloes et Fĕrri—Pills of Aloes and Iron.**—Each pill contains about 1 grain (0.07 Gm.), each, of aloes, dried ferrous sulphate, and aromatic powder.
Dose.—1 to 4 pills.

Pĭlulæ Āloes et Măstiches—Pĭlulas (acc.) **Āloes et Măstiches—Pills of Aloes and Mastich.**—Each pill contains about 2 grains (0.13 Gm.), together with mastich and red rose (Lady Webster's Dinner Pill).
Dose.—1 to 3 pills.

Pĭlulæ Āloes et Mȳrrhæ—Pĭlulas (acc.) **Āloes et Mȳrrhæ—Pills of Aloes and Myrrh.**—Each pill contains 2 grains (0.13 Gm.), together with myrrh and aromatic powder.
Dose.—1 to 3 pills.

Pĭlulæ Rhēi Compŏsitæ—Pĭlulas (acc.) **Rhēi Compŏsitas—Compound Pills of Rhubarb.**—Each pill contains 1½ grains (0.10 Gm.) of aloes.
Dose.—1 to 3 pills.

Pĭlulæ Laxatīvæ Compŏsitæ—Pĭlulas Laxatīvæ Compŏsitæ—Compound Laxative Pills (U. S. P.).—Each pill contains ⅕ grain (0.013 Gm. = 13 milligrammes) aloin, $\frac{1}{128}$ grain (0.0005 Gm. = 0.5 milligramme) strychnine, ⅛ grain (0.008 Gm. = 8 milligrammes) extract of belladonna leaves, and $\frac{1}{16}$ grain (0.004 Gm. = 4 milligrammes) of ipecac.
Dose.—Average dose: 2 pills (U. S. P.).
Pilulæ aloini, strychninæ et belladonnæ (N. F.), contain, with the exception of the ipecac, the same active ingredients and in the same proportion (Hunt).

Tinctūra Āloes—Tinctūræ Āloes—Tincture of Aloes (10 per cent.).
Dose.—½–1 fluidram (2.0–4.0 Cc.) [30 minims (2 Cc.), U. S. P.].

Tinctūra Āloes et Mȳrrhæ—Tinctūræ Āloes et Mȳrrhæ—Tincture of Aloes and Myrrh (10 per cent. of each, with glycerin 10 per cent.).
Dose.—1–2½ fluidrams (2.0–10.0 Cc.) [80 minims (2 Cc.), U. S. P.].

Tinctūra Benzoīni Compŏsita—Tinctūræ Benzoīni Compŏsitæ—Compound Tincture of Benzoin (2 per cent. of aloes).
Dose.—10–40 minims (0.6–2.6 Cc.), [30 minims (2 Cc.), U. S. P.].

Aloīnum—Aloīni—Aloin (U. S. P.).—*Origin.*—A neutral principle obtained from several varieties of aloes.
Description and Properties.—Minute acicular crystals or a micro-crystalline powder, varying in color from yellow to yellowish-brown; odorless or possessing a slight odor of aloes, of a characteristic, bitter taste, and permanent in the air.
Dose.—½–2 grains (0.03–0.12 Gm.) [1 grain (0.065 Gm.), U. S. P.].

Extrāctum Colocȳnthidis Compŏsitum—Extrācti Colocȳnthidis Compŏsiti—Compound Extract of Colocynth.—*Dose*, 5–25 grains (0.3–1.6 Gm.) [7½ grains (0.5 Gm.), U. S. P.]. (See *Colocynth.*)

Physiological Action.—Aloes has no local action, although the drug is readily absorbed from ulcers or abraded surfaces.

Internally it is stomachic, increasing the secretions from the gastro-intestinal tract. It probably increases the secretion of bile. Its principal action appears to be upon the colon, the muscular coat of which it stimulates, in addition to augmenting the secretion from the large intestine.

In from ten to fifteen hours after the ingestion of the drug it causes soft, dark-colored evacuations, its action being usually attended with more or less griping pain.

The blood-supply to the lower bowel and pelvic viscera is increased by aloes; and the drug, if used habitually, may bring on or aggravate hemorrhoids. The menstrual function is stimulated, the drug being a decided emmenagogue.

Aloes is readily absorbed; it is eliminated through the bowels and kidneys, and is found also in the milk.

Therapeutics.—The principal use of ALOES is as a purgative in *habitual constipation* due to a torpid condition of the large intestine. *Jaundice* resulting from gastro-intestinal catarrh is well treated with aloes and blue pill.

PILLS OF ALOES AND IRON are useful adjuvants to other remedies in the treatment of *chlorosis*. *Amenorrhea*, which is such a common condition in chlorosis, is relieved by aloes. Pills of aloes and iron are equally valuable in *menorrhagia* arising from debility.

Contraindications.—Aloes is ordinarily contraindicated in hemorrhoids, although those cases attended with a mucous discharge are frequently benefited by it, The drug is considered objectionable in pregnancy, in persons of plethoric, bilious, or hemorrhagic constitution, and in menorrhagia of the strong and full-blooded.

Administration.—When desired as a purgative, aloes in pill form is preferable to the liquid preparations, and the drug may be given alone or associated with other purgatives, tonics, or antispasmodics.

Aloin is perhaps to be preferred to aloes, as it gripes less and may be given in smaller doses. It is less certain, however.

Fĕl Bōvis—Fĕllis Bōvis—Oxgall. *U. S. P.*

Origin.—The fresh bile of *Bos Taurus* L.

Description and Properties.—A brownish-green or dark-green, somewhat viscid liquid, having a peculiar, unpleasant odor and a disagreeable, bitter taste.

Dose.—5–15 grains (0.3–1.0 Gm.).

Official Preparation.

Fĕl Bōvis Purificātum—Fĕllis Bōvis Purificāti—Purified Oxgall.—*Description and Properties.*—A yellowish-green, soft solid, having a peculiar odor and a partly sweet and partly bitter taste. Very soluble in water and in alcohol.

Dose.—5–15 grains (0.3–1.0 Gm.) [7½ grains (0.5 Gm.), U. S. P.].

Physiological Action and Therapeutics.—Like bile, oxgall augments the duodenal secretions, emulsionizes fats, and increases intestinal peristalsis. It renders bile more fluid, and acts as a cholagogue and purgative. It is a useful cathartic when the stools are very offensive and of a light-clay color, indicating a deficient biliary secretion. The drug is serviceable in *jaundice* due to obstruction of the common duct by inspissated bile or mucus. *Impacted feces* are readily removed by an enema containing 15 or 20 grains (1.0–1.3 Gm.) of oxgall. The drug is an efficient intestinal antiseptic, and may be beneficially employed for that purpose in *typhoid fever* and *intestinal fermentation*.

Oxgall is usually given in pill form.

Rhēum—Rhēi—Rhubarb. *U. S. P.*

Definition.—The dried rhizome of *Rheum officinale* Baillon, *Rheum palmatum* L., and the var. *tanguticum* Max. or other species of *Rheum*, grown in China or Thibet, and deprived of most of the bark and carefully dried.

Description and Properties.—In cylindrical, conical, or flattish segments, deprived of the dark-brown, corky layer, smoothish or somewhat wrinkled, externally covered with a bright yellowish-brown powder, marked with white, elongated meshes, containing a white, rather spongy tissue, and a number of short, reddish-brown or brownish-yellow striæ; compact, hard; fracture uneven; internally white, with numerous red, irregularly-curved, and interrupted medullary rays, which are radially parallel only near the cambium line; odor somewhat peculiar, aromatic; taste bitter, somewhat astringent. When chewed, rhubarb feels gritty between the teeth and imparts a yellow color to the saliva. Rhubarb which is very porous, or has a prominently mucilaginous taste, or is of a dark-brown color internally, should be rejected.

The drug contains the following constituents: *chrysophan* (and chrysophanic acid), emodin, imperfectly isolated glycosides as cathartin, or cathartinic acid, rheotannic acid, starch, calcium oxalate, etc,

Dose.—5–30 grains (0.32–1.94 Gm.) [15 grains (1 Gm.), U. S. P.].

Official Preparations.

Extrăctum Rhēi—Extrăcti Rhēi—Extract of Rhubarb.—*Dose*, 3–15 grains (0.19–1.0 Gm.) [4 grains (0.25 Gm.), U. S. P.].

Fluidextrăctum Rhēi—Fluidextrăcti Rhēi—Fluidextract of Rhubarb.—(This preparation is used in Mistura Rhei et Sodæ and in Syrupus Rhei).

Dose.—5–30 minims (0.3–2.0 Cc.) [15 minims (1 Cc.), U. S. P.].

Pĭlulæ Rhēi Compŏsitæ—Pĭlulas (acc.) Rhēi Compŏsitas—Compound Rhubarb Pills.—Each pill contains about 2 grains (0.12 Gm.) of rhubarb, with purified aloes 1½ grains (0.09 Gm.), myrrh, and oil of peppermint.

Dose.—1 to 3 pills.

Pŭlvis Rhēi Compŏsitus—Pŭlveris Rhēi Compŏsiti—Compound Rhubarb Powder (GREGORY'S POWDER).—(25 per cent. with magnesia and ginger).

Dose.—½–1 dram (2.0–4.0 Gm.) [30 grains (2 Gm.), U. S. P.].

Tinctūra Rhēi—Tinctūræ Rhēi—Tincture of Rhubarb.—(20 per cent., with cardamom).

Dose.—½–4 fluidrams (2.0–15.0 Cc.) [1 fluidram (4 Cc.), U. S. P.].

Tinctūra Rhēi Aromătica—Tinctūræ Rhēi Aromăticæ—Aromatic Tincture of Rhubarb.—(20 per cent., with cassia, cinnamon, cloves, and nutmeg).

Dose.—1–3 fluidrams (4.0–12.0 Cc.) [30 minims (2 Cc.), U. S. P.].

This preparation is used to make Syrupus Rhei Aromaticus.

Mistūra Rhēi et Sōdæ—Mistūræ Rhēi et Sōdæ—Mixture of Rhubarb and Soda.—Formula: Sodium bicarbonate, 35; fluidextract of rhubarb, 15; fluidextract of ipecac, 3; glycerin, 350; spirit of peppermint, 35; water, to 1000.

Dose.—¼–2 fluidounces (8.0–60.0 Cc.) [1 fluidram (4 Cc.), U. S. P.].

Sȳrupus Rhēi—Sȳrupi Rhēi—Syrup of Rhubarb.—Formula: Fluidextract of rhubarb, 100; potassium carbonate, 10; spirit of cinnamon, 4; water, 50; syrup, to 1000.

Dose.—1–4 fluidrams (4.0–15.0 Cc.) [2 fluidrams (8 Cc.), U. S. P.].

Sȳrupus Rhēi Aromăticus—Sȳrupi Rhēi Aromătici—Aromatic Syrup of Rhubarb.—Formula: Aromatic tincture of rhubarb, 150; potassium carbonate syrup, 850.

Dose.—½–2 fluidrams (2.0–8.0 Cc.) [2 fluidrams (8 Cc.), U. S. P.].

Physiological Action and Therapeutics.—Rhubarb in moderate doses is a stomachic, acting similarly to the aromatic bitters, increasing secretion, peristalsis, vascularity, and absorption, thereby aiding digestion and serving as a tonic. In larger doses it is a mild cathartic, producing in from four to eight hours a soft yellowish-brown evacuation, not watery, which is not infrequently accompanied by griping.

After full doses of rhubarb have been taken the purgative action

is succeeded by quiescence of the bowels, the constipation being the result of the action of the astringent constituents of the rhubarb. Small doses, however, taken daily, serve a useful purpose in relieving *habitual constipation* without in the least impairing digestion.

The drug is excreted with the feces, urine, perspiration, and milk; the urine is slightly increased in amount and, together with the perspiration and milk, is colored yellow. The milk acquires a bitter taste and purgative properties.

Rhubarb is one of the best purgatives for children suffering from *diarrhea* caused by irritating ingesta in the bowels or to cold; it is also of value in some cases of *dysentery*. *Summer diarrhea of children* is often cured by some preparation of rhubarb alone, the diarrhea ceasing after a free purge by the drug.

As a simple laxative for children it is a valuable remedy, owing to its secondary tonic and astringent effects, and is recommended as a laxative to expel *thread-worms.*

When *hemorrhoids* are connected with constipation, much relief may be obtained by the gentle action of rhubarb.

Administration.—Rhubarb is seldom given alone, because of the griping it occasions. For children the syrups are excellent preparations, and the mixture of rhubarb and soda is an appropriate remedy when the secretions of the stomach and bowels are unduly acid.

In habitual constipation of adults the simple rhubarb pill is an efficient preparation.

The choice of the preparation will depend largely upon the individual case.

Euŏnymus—Euŏnymi—Euonymus. *U. S. P.*

(Wahoo.)

Origin.—The dried bark of the root of *Euonymus atropurpureus* Jacquin, a shrub 6 to 10 or 14 feet (1.8–3 or 4.2 M.) high, found growing in shady woods of the northern and middle section of the United States, east of the Mississippi.

Description and Properties.—In quilled or curved pieces $\frac{1}{12}$ to $\frac{1}{5}$ inch (2–5 Mm.) thick; outer surface ash-gray, with blackish patches, detached in thin and small scales; inner surface whitish or slightly tawny, smooth; fracture smooth, whitish, the inner layers of a laminated appearance; nearly inodorous; taste sweetish, somewhat bitter and acrid.

The chief constituent of the drug is a glycoside, *euonymin.*

Dose.—1–2 drams (4.0–8.0 Gm.) [7½ grains (0.5 Gm.), U. S. P.].

Official Preparations.

Extrăctum Euŏnymi—Extrăcti Euŏnymi—Extract of Euonymus.—*Dose,* 1–5 grains (0.06–0.3 Gm.) [2 grains (0.125 Gm.), U. S. P.].

Fluidextrăctum Euŏnymi—Fluidextrăcti Euŏnymi—Fluidextract of Euonymus (U. S. P.).—The solid extract of euonymus, which was already official, is now prepared from this fluidextract.

Dose.—Average dose: 8 minims (0.5 Cc.), U. S. P.

Physiological Action and Therapeutics.—Euonymus resembles rhubarb in its action, but is milder, small doses being stimu-

lant to the stomach. The drug is an active hepatic stimulant, increasing the secretion of bile and facilitating its excretion into the intestine. It is excreted by the kidneys and bronchopulmonary mucous membrane, being a mild diuretic and expectorant. Euonymus is an excellent cathartic, particularly in cases of *constipation* attended with impaired functional activity of the liver.

Euonymin is an impure resin, and is not yet reliable. The official fluidextract of euonymus is a reliable preparation.

Leptăndra—Leptăndræ—Leptandra. *U. S. P.*

(CULVER'S ROOT.)

Origin.—The dried rhizome and roots of *Veronica virginica* L., a plant indigenous in Canada, and in the United States as far west as the Mississippi Valley.

Description and Properties.—Of horizontal growth, from 4 to 6 inches (10–15 Cm.) long and about ¼ inch (6 Mm.) thick, somewhat flattened, bent and branched, deep blackish-brown, with cup-shaped scars on the upper side, hard, of a woody fracture, with a thin, blackish bark, a hard, yellowish wood, and a large, purplish-brown, about six-rayed pith; roots thin, wrinkled, very fragile; inodorous; taste bitter and feebly acrid.

Leptandra contains a crystalline glycoside, *leptandrin*, besides tannin, gum, and a small quantity of volatile oil.

Dose.—15–60 grains (1.0–4.0 Gm.) [15 grains (1 Gm.), U. S. P.].

Official Preparations.

Extrăctum Leptăndræ—Extrăcti Leptăndræ—Extract of Leptandra.—*Dose*, 1–5 grains (0.06–0.3 Gm.) [4 grains (0.25 Gm.), U. S. P.].

Fluidextrăctum Leptăndræ—Fluidextrăcti Leptăndræ—Fluidextract of Leptandra.—*Dose*, 15–60 minims (1.0–4.0 Cc.) [15 minims (1 Cc.), U. S. P.].

The **Pĭlulæ Cathărticæ Vegetăbiles** contain ¼ grain (0.01 Gm.) of the extract of leptandra to each pill.

Leptăndrin (NON-OFFICIAL).—*Dose*, 1–3 grains (0.06–0.2 Gm.). An impure mixture of resins is on the market.

Physiological Action and Therapeutics.—The action of leptandra is similar to the actions of euonymus, iris, and juglans, the green root, however, being more of an irritant to the gastro-intestinal tract, possessing marked emetocathartic properties.

It is thought to be an active hepatic stimulant, and may be advantageously employed for the same purposes as euonymus, iris, etc.

Sĕnna—Sĕnnæ—Senna. *U. S. P.*

Origin.—The dried leaflets of *Cassia acutifolia* Delile (Alexandria senna) or of *Cassia augustifolia* Vahl (India senna), small shrubs found in Upper Egypt and southward to Nubia, Sennaar, and Kordofan, and farther westward in tropical Africa (*Cassia acutifolia*), and in Southwestern Arabia, along the Somali coast of Africa, and eastward in Northern India (*Cassia angustifolia*).

Description and Properties.—*Alexandria senna* consists of leaflets about 1 inch (25 Mm.) long and ⅜ inch (10 Mm.) broad, lanceolate or lance-oval, subcoriaceous, brittle, rather pointed, unequally oblique at the base, entire, grayish-green, somewhat pubescent; of a peculiar odor, and a nauseous, bitter taste.

India senna consists of leaflets 1 to 2 inches (2.5–5 Cm.) long and ⅜ to ⅝ inch (10–15 Mm.) broad, lanceolate, acute, unequally oblique at the base, entire, thin, yellowish-green or dull-green, nearly smooth; odor peculiar, somewhat tea-like; taste mucilaginous, bitter, and nauseous.

Senna contains a sulphuretted glycosid, *cathartic acid*, to which the purgative

properties of the drug are due. Senna also contains *chrysophan*, besides sennacrol and sennapicrin (two bitter principles), catharto-mannite, mucilage, etc.

Dose.—10 grains to 3 drams (0.6–12.0 Gm.) [60 grains (4 Gm.), U. S. P.].

Official Preparations.

Confĕctio Sĕnnæ—Confectiōnis Sĕnnæ—Confection of Senna.—10 per cent. with cassia fistula, tamarind, prune, fig, sugar, and oil of coriander. *Dose*, 1–3 drams (4.0–12.0 Gm.) [60 grains (4 Gm.), U. S. P.].

Fluidextrăctum Sĕnnæ—Fluidextrăcti Sĕnnæ—Fluidextract of Senna.—*Dose*, 10 minims to 3 fluidrams (0.6–11.09 Cc.) [30 minims (2 Cc.), U. S. P.].

Infūsum Sĕnnæ Compŏsitum—Infūsi Sĕnnæ Compŏsiti—Compound Infusion of Senna.—6 per cent., with manna and magnesium sulphate, each 12 per cent., and fennel 2 per cent. *Dose*, 1–2½ fluidounces (30.0–75.0 Cc.) [4 ounces (120 Cc.), U. S. P.].

Pŭlvis Glycyrrhīzæ Compŏsitus—Pŭlveris Glycyrrhīzæ Compŏsiti—Compound Powder of Glycyrrhiza.—Formula: Senna, 180; glycyrrhiza, 236; oil of fennel, 4; washed sulphur, 80; sugar, 500.

Dose.—½–2 drams (2.0–8.0 Gm.) [60 grains (4 Gm.), U. S. P.].

Sȳrupus Sĕnnæ—Sȳrupi Sĕnnæ—Syrup of Senna (25 per cent.).—*Dose*, ¼–1 fluidounce (8.0–30.0 Cc.) [1 fluidram (4 Cc.), U. S. P.].

Sȳrupus Sarsaparillæ Compŏsitus contains 15 per cent. of the fluidextract of senna.

Dose.—4 drams (16 Cc.), U. S. P.

Physiological Action and Therapeutics.—Senna is an active purgative, acting upon nearly the entire intestinal tract, increasing both peristalsis and intestinal secretion, although having but little effect upon the biliary secretion. It is apt to occasion much flatulence and griping unless it is associated with aromatics. Full doses open the bowels in from four to eight hours, producing one or more copious liquid, yellow stools, but never occasioning hypercatharsis, and the purgation is not followed by constipation.

An infusion of senna, if injected into the veins, excites both vomiting and purging.

Some persons are so susceptible to the influence of senna as to be purged even by its odor.

The drug, or some constituent of it, is eliminated by the urine, to which it imparts a red color, and by the milk, rendering it purgative.

The various preparations of senna are very efficient purgatives in cases of simple *constipation* or in cases of *fecal accumulation in the colon.*

INFUSION OF SENNA is an admirable purgative with which to succeed the administration of blue pill. In cases of *biliousness* there is probably no better treatment than calomel or blue pill at night and infusion of senna in the morning.

Habitual constipation and the *constipation of pregnancy* are safely and agreeably treated by COMPOUND LIQUORICE POWDER.

Administration.—Senna is seldom given alone, but is generally associated with some corrective to prevent griping.

The infusion, compound liquorice powder, syrup, and confection of senna are employed.

The compound liquorice powder and the confection being the

mildest and pleasantest, the latter preparation, when coated with chocolate, is readily taken by children, and in this form is the well-known laxative "*Tamar Indien.*" Many of the household teas and proprietary laxatives contain senna. The laity should be cautioned against their use.

HYDRAGOGUE PURGATIVES.

These drugs are more active than the preceding class, producing an abundant secretion from the intestinal mucous membrane, removing a large quantity of water from the blood-vessels, and producing several copious, watery stools.

Ōleum Tĭglii—Ōlei Tĭglii—Croton Oil. *U. S. P.*

Origin.—A fixed oil expreesed from the seed of *Croton Tiglium* L., indigenous in Hindustan and some of the East Indian and Philippine islands.

Description and Properties.—A pale-yellow or brownish-yellow, somewhat viscid, and slightly fluorescent liquid, having a slight, fatty odor and a mild, oily, afterward acrid and burning taste (*great caution is necessary in tasting*). Croton oil should be kept in small, well-stoppered bottles, and should be handled with caution, for when applied to the skin it produces rubefaction or a pustular eruption.

When fresh, croton oil is soluble in about 60 parts of alcohol, the solubility increasing by age.

Croton oil is broken up into crotonoleic acid which resembles in its action ricinoleic acid, but is much more powerful.

Dose.—¼–2 minims (0.01–0.12 Cc.) on a lump of sugar or mixed with some bland oil [1 minim (0.05 Cc.), U. S. P.].

Physiological Action.—*Externally and Locally.*—Croton oil is a powerful irritant when applied to the skin, exciting inflammation and quickly producing vesication, which rapidly merges into pustules closely resembling those of variola, and perhaps lasting several days. In many cases permanent cicatrices mark the sites of these pustules.

If the drug be rubbed over the abdomen, it may produce purgation. The irritating action is wholly due to the free crotonoleic acid which the oil contains.

Internally.—When a drop or two of croton oil is taken into the stomach it occasions a sense of heat in the epigastrium, which is soon succeeded by griping and abdominal pain, and in from half an hour to two hours after the ingestion of the drug there are produced profuse watery stools, with considerable burning and irritation about the anus.

The drug greatly increases the vascularity of, and the secretion from, the gastro-intestinal tract, without specially influencing the biliary secretion.

Large doses produce violent gastro-enteritis, hypercatharsis, with great prostration and collapse resembling that of cholera.

In case of *poisoning* the stomach should be immediately evacuated, and demulcent drinks freely given. Opium and stimulants may be necessary.

Therapeutics.—*Externally and Locally.*—The external use of croton oil is comparatively limited.

Croton oil has been put to many uses, but the results obtained are so unsatisfactory that it is needless to enumerate them.

Internally.—The drug is used as a purgative, as a rule, only in cases of emergency, and then a single dose is usually sufficient. It is employed in such cases as *intestinal obstruction from accumulated feces* produced by torpor of the bowels, *diseases of the nervous system*, *lead-poisoning*, etc. In *lead colic* it is probably superior to all other purgatives.

Croton oil is sometimes employed for its revulsive action in *apoplexy*.

As a purgative it is frequently given to the insane, because, on account of the smallness of the dose, it may be easily placed on the back of the tongue, where it is quickly swallowed reflexly.

Contraindications.—The drug should never be given to pregnant women, to children, nor to patients suffering from hemorrhoids, peritonitis, gastritis, or enteritis.

Administration.—Croton oil may be given in emulsion, or mixed with some bland oil, or dropped on a piece of loaf sugar, or in pill form.

The best excipient for pills of croton oil is breadcrumb.

Elaterīnum—Elaterīni—Elaterin. *U. S. P.*

Origin.—A neutral principle obtained from elateriam, a substance deposited by the juice of the fruit or *Ecballium elaterium* L., commonly known as "squirting cucumber," a vine growing in the Mediterranean regions of Europe, Africa, and Asia.

Description and Properties.—Minute, white, hexagonal scales or prismatic crystals, without odor, and having a slightly acrid, bitter taste; permanent in the air; soluble in 4250 parts of water and 337 parts of alcohol.

Dose.—$\frac{1}{30}$–$\frac{1}{12}$ grain (0.002–0.005 Gm.) [$\frac{1}{10}$ grain (0.005 Gm.), U. S. P.].

Official Preparation.

Triturātio Elaterīni—Trituratiōnis Elaterīni—Trituration of Elaterin.—*Dose*, about ¾ grain (0.05 Gm.) [½ grain (0.03 Gm.), U. S. P.].

Physiological Action and Therapeutics.—Elaterin is the most powerful hydragogue purgative known.

The drug greatly increases the salivary, gastric, and intestinal secretions, as well as those from the liver and pancreas.

It is a violent purgative, whether given internally or injected subcutaneously, producing abundant watery evacuations attended with much griping pain and great prostration.

Elaterin is indicated where profuse serous discharges are desired, as in cases of *congestion of the brain* and *lungs*, *ascites*, and *chronic nephritis*.

Contraindications.—The drug is not permissible in inflammatory conditions of the gastro-intestinal tract, nor in pregnancy, and it should be administered with much care, if at all, in *heart disease*.

Administration.—The drug may be given in pill form, in alcoholic solution, or in the form of the trituration. Elaterin varies greatly in strength, which suggests caution in its use.

Cambōgia—Gambōgiæ—Gamboge. *U. S. P.*

Origin.—A gum-resin obtained from *Garcinia Hanburii* Hooker filius, a medium-sized tree, indigenous in Siam, Cambodia, and Cochin-China.

Description and Properties.—In cylindrical pieces, sometimes hollow in the center, 1 to 2 inches (2–5 Cm.) in diameter, longitudinally striate on the surface; fracture flattish-conchoidal, of a waxy luster, orange-red; in powder bright yellow; inodorous; taste very acrid; the powder sternutatory. Gamboge is partly soluble in alcohol and ether. Cambogic acid is thought to be its active principle.

Dose.—1–5 grains (0.06–0.32 Gm.) [2 grains (0.125 Gm.), U. S. P.].

Official Preparation.

Pĭlulæ Cathărticæ Compŏsitæ—Pĭlulas (acc.) **Cathărticas Compŏsitas—Compound Cathartic Pills.**—*Dose,* 1–3 pills.

Physiological Action and Therapeutics.—Gamboge is a violent hydragogue purgative, exciting active peristalsis and greatly augmenting the secretion from the intestinal glands, although not increasing the secretion of bile. Small and repeated doses are slightly diuretic, coloring the urine yellow.

Gamboge is seldom given alone, being usually associated with other purgatives. It is used in combination when a hydragogue action by the kidneys, as well as the bowels, is desired. It is thought to be of use in *hepatic congestion* arising from malarial causes. The drug is an efficient anthelmintic, and is occasionally prescribed with vermicide medicines.

DRASTIC PURGATIVES.

These drugs are even harsher in their action than hydragogue purgatives, exciting violent peristalsis, and in large doses producing gastro-enteritis and all the symptoms occasioned by an irritant poison. The evacuations produced by these drugs are numerous, copious, and watery, attended with much griping pain, tenesmus, and borborygmi.

Colocȳnthis—Colocȳnthidis—Colocynth. *U. S. P.*

Origin.—The peeled, dried fruit of *Citrullus Colocynthis* Schroder. The colocynth plant is indigenous in Japan, and is cultivated and naturalized in Spain.

Description and Properties.—From 2 to 4 inches (5–10 Cm.) in diameter; globular; white or yellowish white, light, spongy; readily breaking into three wedge-shaped pieces, each containing, near the rounded surface, many flat, ovate, brown seeds; inodorous; taste intensely bitter.

The active constituent of colocynth is *colocynthin,* a glycosid, of which there is present about 2 per cent. Colocynth also contains resin, gum, and an amyloid principle.

Dose.—5–10 grains (0.3–0.6 Gm.) [1 grain (0.065 Gm.), U. S. P.].

Official Preparations.

Extrăctum Colocўnthidis—Extrăcti Colocўnthidis—Extract of Colocynth. —*Dose*, ½–2 grains (0.03–0.13 Gm.) [½ grain (0.03 Gm.), U. S. P.].

Extrăctum Colocўnthidis Compŏsitum—Extrăcti Colocўnthidis Compŏsiti —Compound Extract of Colocynth.—Extract of colocynth, 16 per cent., with aloes, scammony, cardamom, and soap.

Dose.—5–25 grains (0.3–1.6 Gm.) [7½ grains (0.5 Gm.), U. S. P.].

Compound extract of colocynth enters into the following pills:

Pĭlulæ Cathărticæ Compŏsitæ (8 per cent.).

Pĭlulæ Cathărticæ Vegetăbiles (6 per cent.).

Physiological Action and Therapeutics.—The action of colocynth is very similar to that of elaterin. In small doses, however, it acts as a stomachic, improving the appetite and augmenting the secretions of the whole gastro-intestinal tract. Colocynth is a decided cholagogue.

Pills containing colocynth are useful to produce abundant watery evacuations, as is necessary sometimes in the treatment of *hepatic* and *renal diseases* where there is *constipation* and *ascites*.

The drug should be employed only when there is some marked indication for its use, as colocynth, like the other drastics, is too irritant for habitual use.

Gastro-intestinal inflammation, pregnancy, etc., would contraindicate its use.

Jalāpa—Jalāpæ—Jalap. *U. S. P.*

Origin.—The dried tuberous root of *Exogonium purga* (Wend.) Bentham, yielding not less than 8 per cent. of total resin, but not more than 1.5 per cent. of resin soluble in ether. Jalap is a twining herbaceous perennial, growing in damp and shady woods on the eastern slope of the Mexican Andes. It has been introduced into India and Jamaica.

Description and Properties.—Napiform, pyriform, or oblong, varying in size, the large roots incised, more or less wrinkled, dark brown, with lighter-colored spots and short transverse ridges; hard, compact, internally pale-grayish brown, with numerous concentric circles composed of small resin-cells; fracture resinous, not fibrous; odor slight, but peculiar, smoky, and sweetish; taste sweetish and acrid.

Jalap contains two glycosides, *jalapin* and *convolvulin*, which are the active principles of the drug.

Dose.—5–30 grains (0.32–2.0 Gm.) [15 grains (1 Gm.), U. S. P.].

Official Preparations.

Pŭlvis Jalăpæ Compŏsitus—Pulvĕris Jalăpæ Compŏsiti—Compound Jalap Powder (35 per cent., with potassium bitartrate).—*Dose*, 15–60 grains (1.0–4.0 Gm.) [30 grains (2 Gm.), U. S. P.].

Resīna Jalăpæ—Resīnæ Jalăpæ—Resin of Jalap.—*Description and Properties.* —Yellowish-brown or brown masses or fragments, breaking with a resinous, glossy fracture, translucent at the edges, or a yellowish-gray or yellowish-brown powder, having a slight peculiar odor, and a somewhat acrid taste. Permanent in the air. Soluble in alcohol in all proportions.

Dose.—2–5 grains (0.13–0.3 Gm.) [2 grains (0.125 Gm.), U. S. P.].

Extract of jalap is one of the ingredients of **Pilulæ Catharticæ Compositæ** and **Pilulæ Catharticæ Vegetabiles.**

Physiological Action and Therapeutics. — The purgative action of jalap is developed in the duodenum, where it comes in

contact with the bile. The secretion from the intestinal glands is greatly augmented, as well as the vascularity and peristalsis of the intestines. The biliary flow is but little affected.

Purgation is produced by jalap in three or four hours, the evacuations being profuse and watery and attended with griping pain.

Jalap—or, preferably, the compound jalap powder—is a reliable hydragogue cathartic for the removal of *dropsical effusions*, being especially appropriate for nephritic patients.

Small doses of jalap are serviceable in *constipation* due to deficient intestinal secretion.

The drug is frequently associated with anthelmintic medicines as a vermifuge.

Scammōnium—Scammōnii—Scammony. *U. S. P.*

Definition.—A gum resin obtained by incising the living root of *Convolvulus Scammonia* L. Scammony is an herbaceous, twining perennial, growing in Syria, Asia Minor, and Greece.

Description and Properties.—Occurring in irregular angular pieces or circular cakes, greenish gray or blackish, internally porous, and breaking with an angular fracture, of a resinous luster; odor peculiar, somewhat cheese-like; taste slightly acrid; powder gray or greenish gray.

It contains a glycoside, *jalapin*, which is the active principle, besides gum, starch, etc.

Dose.—1–15 grains (0.06–1.0 Gm.) [4 grains (0.25 Gm.), U. S. P.].

Official Preparation.

Resīna Scammōnii—Resīnæ Scammōnii—Resin of Scammony.—*Description and Properties.*—Yellowish-brown or brownish-yellow masses or fragments, breaking with a glossy, resinous fracture, translucent at the edges, or a yellowish-white or grayish-white powder, having a faint, peculiar odor, and a slight, peculiar taste. Soluble in alcohol in all proportions.

Dose.—1–8 grains (0.06–0.5 Gm.) [3 grains (0.20 Gm.), U. S. P.].

Physiological Action and Therapeutics.—The action of scammony is identical with that of jalap, save that it stimulates the muscular coat of the intestines more, producing more irritation and griping than jalap, though not increasing secretion so much as the latter drug.

The therapeutics are the same as for jalap.

The drug may be given in powder, emulsion, or in milk, but is less inactive in pilular form.

Podophȳllum—Podophȳlli—Podophyllum. *U. S. P.*

(May Apple.)

Origin.—The dried rhizome and roots of *Podophyllum peltatum* L., an herbaceous perennial growing in rich woodlands in Canada and the United States.

Description and Properties.—Of horizontal growth, consisting of joints about 2 inches (5 Cm.) long, flattish cylindrical, about ¼ inch (6 Mm.) thick, but somewhat enlarged at the end, which has a circular scar on the upper side, a tuft of about ten nearly simple, fragile roots on the lower side, and is sometimes branched

laterally; smooth or somewhat wrinkled, orange-brown, internally white and mealy, with a circle of small wood-bundles; pith large; nearly inodorous; taste sweetish; somewhat bitter and acrid.

Podophyllum contains a resin, *podophyllin*, composed principally of two anhydrous isomeric, glycosides *podophyllotoxin* and *picropodophyllin*. These represent the active principles, although attempts have been made to show that picropodophyllin is included in the composition of the former glycoside. Among other constituents of the drug are several minor resins and a coloring principle.

Dose.—5–20 grains (0.32–1.29 Gm.) [7½ grains (0.5 Gm.), U. S. P.].

Official Preparations.

Fluidextrăctum Podophȳlli—Fluidextrăcti Podophȳlli—Fluidextract of Podophyllum.—*Dose*, 5–20 minims (0.32–1.29 Cc.) [8 minims (0.5 Cc.), U. S. P.].

Resīna Podophȳlli—Resīnæ Podophȳlli—Resin of Podophyllum.—*Description and Properties.*—An amorphous powder, varying in color from grayish-white to pale greenish-yellow or yellowish-green, turning darker when exposed to heat; having a slight peculiar odor and a peculiar, faintly bitter taste; permanent in the air; soluble in alcohol in all proportions.

Dose.—⅛–1 grain (0.008–0.06 Gm.) [1/10–¼ grain (0.005–0.015 Gm.), U. S. P.].

Pĭlulæ Podophȳlli, Belladŏnnæ et Căpsici—Pĭlulas Podophȳlli, Belladŏnnæ et Căpsici—Pills of Podophyllum, Belladonna and Capsicum.—Each pill contains ¼ grain (0.016. Gm. = 16 milligrammes) resin of podophyllum, ⅛ grain (0.008 Gm. = 8 milligrammes) extract of belladonna leaves, and ½ grain (0.032 Gm. = 30 milligrammes) capsicum.

Dose.—Average dose: 1 pill (U. S. P.).

Physiological Action and Therapeutics.—The powdered root is an irritant to the skin, and when inhaled occasions a decided irritation of the eyes and respiratory passages. It is absorbed when applied to ulcers and raw surfaces, producing its characteristic purgative effects. The drug is a gastro-intestinal irritant, being apt to excite nausea, in full doses producing salivation and greatly augmenting the intestinal secretions, and especially the bile. Under full doses of podophyllum there is marked peristalsis, attended with severe griping pains, and in the course of ten or twelve hours there is produced a complete evacuation of the bowels, the feces being liquid and deeply stained with bile.

The drug is thought to be an active hepatic stimulant and cholagogue, it is a peculiarly appropriate remedy in that condition known as *torpor of the liver*. The *constipation* attending *hepatic cirrhosis* and *cancer*, as well as that from any hepatic disorder, is well treated by podophyllum.

The slowness and completeness of its action, together with its property of stimulating the functional activity of the liver, renders the drug extremely serviceable in the treatment of *habitual constipation* from any cause.

It should, however, be associated with antispasmodics, such as hyoscyamus or belladonna, to overcome its griping. When associated with other purgatives care should be exercised to select those only which, like itself, are tardy in their action.

Owing to the susceptibility of certain persons to the drug, the dosage should be small at first and gradually increased as necessary.

SALINE CATHARTICS.

Līquor Magnēsii Citrātis—Liquōris Magnēsii Citrātis—Solution of Magnesium Citrate. *U. S. P.*

Formula: Dissolve magnesium carbonate, 15, in a solution of citric acid, 33; add syrup of citric acid, 60; then crystals of potassium bicarbonate, 2.5. Cork the bottle and wire immediately. The product effervesces when uncorked.

Dose.—2–8 fluidounces (60.0–237.0 Cc.) [12 fluidounces (360 Cc.), U. S. P.].

Magnēsii Sŭlphas—Magnēsii Sulphātis—Magnesium Sulphate. *U. S. P.*

(Epsom Salt.)

Origin.—Obtained by the action of sulphuric acid upon native magnesium carbonate, treated with water, filtered, and the filtrate evaporated to crystallization.

Description and Properties.—Small, colorless, rhombic prisms or acicular crystals, without odor, and having a cooling, saline, and bitter taste; slowly efflorescent in dry air. Soluble in 1.5 parts of water; insoluble in alcohol.

Dose.—¼–1 ounce (8.0–32.0 Gm.) [½ ounce (16 Gm.), U. S. P.].

Antagonists and Incompatibles.—Magnesium sulphate is incompatible with alkaline carbonates, phosphoric acid, phosphates, lead acetate, silver nitrate, and lime water.

Synergists.—Saline purgatives.

Magnēsii Sŭlphas Efferv̆escens—Magnēsii Sulphātis Efferv̆escentis—Effervescent Magnesium Sulphate. *U. S. P.*

Magnesium sulphate, 500; sodium bicarbonate, 403; tartaric acid, 211; citric acid, 136.

This may take the place of magnesii citras effervescens (U. S. P., 1890), which has been dropped.

Dose.—Average dose: 240 grains (16 Gm.), U. S. P.

Potăssii Sŭlphas—Potăssii Sulphātis—Potassium Sulphate. *U. S. P.*

Origin.—Prepared by adding potassium carbonate to acid potassium sulphate.

Description and Properties.—Hard, colorless, transparent, six-sided, rhombic prisms terminated by pyramids, or in white powder; odorless, and having a somewhat bitter, saline taste. Permanent in the air. Soluble in about 9 parts of water, insoluble in alcohol.

Dose.—½–4 drams (2.0–16.0 Gm.) [30 grains (2 Gm.), U. S. P.].

Potăssii et Sōdii Tărtras—Potăssii et Sōdii Tartrātis—Potassium and Sodium Tartrate. *U. S. P.*

(Rochelle Salt.)

Origin.—Prepared by adding acid potassium tartrate to a hot solution of sodium carbonate.

Description and Properties.—Colorless, transparent rhombic prisms, or a white powder, odorless, and having a cooling, saline taste. The crystals slightly effervesce in dry air. Soluble in 1.4 parts of water, almost insoluble in alcohol.

Dose.—30 grains to 1 ounce (2.0–32.0 Gm.) [120 grains (8 Gm.), U. S. P.].

Official Preparation.

Pulvis Effervescens Compositus—Pulveris Effervescentis Compositi—Compound Effervescing Powder (SEIDLITZ POWDER).—Each powder has of Rochelle salt, 93; of sodium bicarbonate, 31, mixed in a blue paper; and of tartaric acid, 27 grains, in a white paper.

Dose.—One or two of each dissolved separately in separate quantities of water, the solutions poured together and drunk while effervescing.

Sōdii Phŏsphas—Sōdii Phosphātis—Sodium Phosphate. *U. S. P.*

(SODIUM ORTHOPHOSPHATE.)

Origin.—Prepared by digesting bone ash with sulphuric acid. The solution is filtered, and to it is added sodium carbonate, and the filtrate evaporated to crystallization.

Description and Properties.—Large, colorless, monoclinic prisms, odorless, and having a cooling, saline taste. The crystals effloresce in the air, and gradually lose 5 molecules of water of crystallization. Soluble in 5.5 parts of water; insoluble in alcohol. Sodium phosphate should be kept in well-stoppered bottles, in a cool place.

Dose.—5 grains to 1 ounce (0.32–32.0 Gm.) [30 grains (2 Gm.), U. S. P.].

Official Preparations.

Sōdii Phŏsphas Exsiccātus, 15 grains (1 Gm.).
Sōdii Pyrophŏsphas, 30 grains (2 Gm.).
Sōdii Phŏsphas Effervĕscens, 2 drams (8 Gm.).
Līquor Sōdii Phosphātis Compŏsitus, 2 drams (8 Cc.), are all useful.

Sōdii Sŭlphas—Sōdii Sulphātis—Sodium Sulphate. *U. S. P.*

(GLAUBER'S SALT.)

Origin.—The residue left in the manufacture of hydrochloric acid from salt is neutralized with sodium carbonate.

Description and Properties.—Large, colorless, transparent, monoclinic prisms or granular crystals; odorless, and having a bitter, saline taste. The salt effloresces rapidly in the air, and finally loses all its water of crystallization. Soluble in 2.8 parts of water and in glycerin; insoluble in alcohol.

Dose.—1–8 drams (4.0–32.0 Gm.) [15 grains (1 Gm.), U. S. P.].

Physiological Action and Therapeutics of the Salines.—These preparations greatly augment the amount of fluid in the intestinal canal. This increase of fluid is not a secretion, but a result of the high osmotic equivalent of the salts, which tends to draw the body-fluids into the intestines, while hindering to a certain extent absorption of fluid from the intestines. The purgative influence is really due to the mechanical action of the fluid in the intestines.

Save the sulphate and phosphate of sodium, the salines have little effect upon the biliary secretions.

The sodium salts are more efficient than the potassium salts as purgatives, owing to their higher osmotic equivalents.

Purgation by the salines is painless, and occurs usually in from two to three hours after administration, there being ordinarily two or three watery evacuations.

In cases of *habitual constipation*, particularly that associated with the *gouty diathesis*, there are no better purgatives than the SALTS OF SODIUM or mineral waters containing them, such as Carlsbad, Marienbad, Hunyadi Janos, Apenta, etc.

For children there is no better purgative than SODIUM PHOSPHATE, especially where the stools show a deficiency of bile. In *duodenal catarrh* excellent results are obtained by this drug; also in *chronic rheumatism*, and to retard the formation of *biliary calculi*.

Concentrated saline purgatives are efficient remedies for the removal of *dropsical* and *pleuritic effusions*.

MAGNESIUM SULPHATE, combined with dilute sulphuric acid, is the most efficient treatment in cases of *chronic lead-poisoning*.

ROCHELLE SALT and SEIDLITZ POWDER are pleasant and useful purgatives in cases of *biliousness*, *migraine*, etc. SOLUTION OF MAGNESIUM CITRATE is used for the same purpose, but, while very palatable and acceptable to the stomach, is not always reliable, besides being apt to occasion slight griping.

Administration.—The salines should be taken dissolved in as concentrated a solution as possible, and ordinarily should be administered in the morning, when the stomach is empty.

ANTHELMINTICS.

Anthelmintics are remedies which kill or expel intestinal worms. Those drugs which kill the parasites are called *vermicides*, and those which simply promote their expulsion are called *vermifuges*.[1] There is little real distinction in these terms.

The *vermicides* are:

Aspidium,	Kamala,
Chenopodium,	Oleum Terebinthinæ,*
Cusso,	Pepo,
Granatum,	Santonica.

The *vermifuges* are:

Calomel,*	Spigelia.
Hydragogue Purgatives,*	

Anthelmintics are here divided according to the kind of intestinal parasite against which they are employed.

The *Oxyuris vermicularis* is a small worm, often called seat-worm or threadworm, that infests the large intestine and rectum. The *Ascaris lumbricoides* is the common roundworm, found chiefly in the small intestine.

The *Tæniæ* are the tapeworms.

Anchylostoma, or *Uncinaria*, is the name given to a genus of important hook worms.

[1] Drugs marked with an asterisk (*) are considered elsewhere.

Remedies employed against the Oxyuris vermicularis:[1]

A weak solution of Carbolic Acid,*	Lime Water,*
Infusion of Quassia,*	Calomel,*
Decoction of Aloes,*	Oleum Terebinthinæ.*

Remedies employed against the Ascaris lumbricoides:

Chenopodium,	Calomel,*
Santonica,	Hydragogue Purgatives,*
Spigelia,	Oleum Terebinthinæ.*

Remedies employed against the Tænia Solium and other varieties of Tænia:

Aspidium,	Kamala,
Cusso,	Pepo,
Granatum,	Oleum Terebinthinæ.*

Remedies for *Anchylostoma* are as for *Ascaris*. Thymol is considered a specific.

Ōleum Chenopōdii—Ōlei Chenopōdii—Oil of Chenopodium. *U. S. P.*

(OIL OF AMERICAN WORMSEED.)

Origin.—A volatile oil distilled from chenopodium.

Description and Properties.—A thin, colorless or yellowish liquid, having a peculiar penetrating, somewhat camphoraceous odor, and a pungent and bitterish taste.

Dose.—2–10 minims (0.12–0.6 Cc.) [3 minims (0.2 Cc.), U. S. P.].

Physiological Action and Therapeutics.—Both the POWDERED SEED and the OIL are efficient anthelmintics, particularly useful to expel roundworms (*Ascarides lumbricoides*) from children. The drug should invariably be followed by a brisk cathartic. The powder may be given suspended in molasses, or the oil may be given dropped upon loaf-sugar, or in the form of an emulsion, or enclosed in capsules.

Santŏnica—Santŏnicæ—Santonica. *U. S. P.*

(LEVANT WORMSEED.)

Origin.—The dried unexpanded flower-heads of *Artemisia pauciflora* Weber, a plant growing in Asia and exclusively collected iu Northern Turkestan.

Description and Properties.—From $\frac{1}{12}$–$\frac{1}{8}$ inch (2–3 Mm.) long, oblong-ovoid, obtuse, smooth, somewhat glossy, grayish-green, after exposure to light brownish-green, consisting of an involucre of about twelve to eighteen closely imbricated, glandular scales with a broad midrib, enclosing four or five rudimentary florets; odor strong, peculiar, somewhat camphoraceous; taste aromatic and bitter. The drug contains about 2 per cent. of a neutral principle, *santonin*, to which its anthelmintic properties are due. It also contains about 1 per cent. of an unimportant volatile oil.

Dose.—10–60 grains (0.6–4.0 Gm.).

[1] Drugs marked with an asterisk (*) are considered elsewhere.

Santonīnum—Santonīni—Santonin. *U. S. P.*

Definition.—The inner anhydride or lactone of santonic acid, obtained from Santonica.

Description and Properties.—Colorless, shining, flattened, prismatic crystals, odorless, and nearly tasteless when first put into the mouth, but afterward developing a bitter taste; not altered by exposure to air, but turning yellow on exposure to light. Nearly insoluble in cold water; soluble in 34 parts of alcohol. Santonin should be kept in dark, amber-colored vials, and should not be exposed to light.

Dose.—¼–1 grain (0.016–0.06 Gm.) for a child; 1–5 grains (0.06–0.32 Gm.) for an adult [1 grain (0.065 Gm.), U. S. P.].

Official Preparation.

Trochīsci Santonīni—Trochīscos (acc.) **Santonīni—Troches of Santonin.** —Each troche contains ½ grain (0.03 Gm.).

Dose.—2 (child) to 10 (adult) troches.

Physiological Action and Therapeutics.—In full or large doses santonin may excite nausea or vomiting, with abdominal pain, diarrhea, eructations, borborygmi, and great thirst. It readily enters the blood, where it exists as sodium santoninate. Large doses may cause giddiness, headache, hallucinations of smell and taste, tremors, and a species of depression, the combination of symptoms forming what is called santonin intoxication.

The drug is chiefly eliminated through the kidneys, small amounts of santonin even imparting to the urine a distinct yellow color if the urine is acid, and a decided purplish or even red color if the urine is alkaline. Under certain circumstances when the urine is decidedly alkaline, as in cases of cystitis, the administration of santonin may produce so marked a discoloration of the urine as to suggest hematuria.

Probably the most remarkable phenomenon attending the ingestion of medicinal doses of santonin is that of xanthopsia or yellow vision, which may continue for several hours. According to Rose, "there occasionally appears before the peculiar yellow sight, after large doses of santonin, a violet color of the field of vision: the intensity of this color is in proportion to the darkness of the objects looked at. All light objects, such as windows, paper, etc., appear actually yellow. Red and blue appear often in their complementary colors, orange and green, so that carmine-red appears pale, madder-red a bronze color, and the sky and blue objects green. This, however, is not always the case, and it has been noticed after the employment of santonin that red appears violet or light, and dark objects appear orange to one person, and to another green."—(Quoted from Lewin.) This peculiar effect of santonin is due, according to Rose, to a nervous change in the retina or in the brain.

Affections of the skin—*e. g.*, urticaria—have occasionally followed the administration of santonin. Decidedly poisonous effects have sometimes been produced by comparatively small amounts of the drug. The symptoms of a fatal case from over-dose of santonin were convulsions accompanied by unconsciousness, twitching of the

eyeballs, dilated pupils, cold sweat, weak pulse, feeble respiration, and, after some hours, sudden death.

In case of poisoning by santonin the remedial measures are internal and external stimulants, eliminants, and artificial respiration. Santonin is certainly a most efficient remedy against the *ascaris*, and to a less extent it is of use against the *oxyuris*. It has no effect on the *tæniæ*.

The drug should be given on an empty stomach, preferably at night, either alone or associated with calomel, and followed in two or three hours by castor oil or other brisk cathartic. It may be administered in the form of a powder mixed with sugar or jelly, or in pills or capsules. Troches of santonin are much used and are very efficient. Care should be taken that they are fresh and that they should not be permitted to remain a great length of time in the intestine.

Spigēlia—Spigēliæ—Spigelia. *U. S. P.*

(PINKROOT.)

Origin.—The dried rhizome and roots of *Spigelia marilandica* L., a plant growing in rich shady woods, chiefly in the southern part of the United States, but found as far northward as Pennsylvania and Wisconsin.

Description and Properties.—Of horizontal growth, about 2 inches (5 Cm.) or more long, about ⅛ inch (3 Mm.) thick, dark purplish-brown, bent, somewhat branched on the upper side, with cup-shaped scars; on the lower side with numerous thin, brittle, light-colored roots about 4 inches (10 Cm.) long; the rhizome internally with a whitish wood and a pith which is usually dark-colored or decayed; odor somewhat aromatic; taste sweetish, bitter, and pungent.

It contains a volatile alkaloid, *spigeline*, which is thought to be the active principle.

Dose.—¼–2 drams (1.0–8.0 Gm.) [60 grains (4 gm.), U. S. P.].

Official Preparation.

Fluidextrăctum Spigēliæ—Fluidextrăcti Spigēliæ—Fluidextract of Spigelia.—*Dose*, ¼–2 fluidrams (1.0–8.0 Cc.) [1 dram (4 Cc.), U. S. P.].

Physiological Action and Therapeutics.—Spigelia is a powerful anthelmintic, being a decided vermifuge against the *Ascaris lumbricoides*. When given alone and in full doses it may produce symptoms of narcotic poisoning. The symptoms are those of depression of the respiration with convulsive seizures and occasionally temporary blindness. This may be obviated by associating it with cathartics and aromatics.

The drug may be administered in the form of a tea, associated with senna, fennel, or other aromatics. The fluidextract is a reliable preparation.

Aspĭdium—Aspĭdii—Aspidium. *U. S. P.*

(MALE FERN.)

Origin.—The dried rhizome of *Dryopteris Filix mas* Schott, or of *Dryopteris marginalis* (L.) Gray, plants indigenous in North America, a portion of South America, Asia, Europe, and some parts of Africa.

Description and Properties.—From 3 to 6 inches (7–15 Cm.) long, ½ to 1 inch (12–25 Mm.) thick, and, together with the closely imbricated, dark-brown, roundish, and slightly curved stipe-remnants, 2 to 3 inches (50–75 Mm.) in diameter; densely covered with brown, glossy, transparent, and soft, chaffy scales; internally pale green, rather spongy; vascular bundles about ten (*Dryopteris Filix mas*) or six (*Dryopteris marginalis*) in number, arranged in an interrupted circle; odor slight, but disagreeable; taste sweetish, acrid, somewhat bitter, astringent, and nauseous. Aspidium contains *filicic acid*, aspidin, aspidinin (phloroglucin allies), which are thought to represent the active principles, fixed oil, a trace of volatile oil, and chlorophyl.

Dose.—½–2 drachms (2.0–8.0 Gm.).

Official Preparation.

Oleoresina Aspidii—Oleoresinæ Aspidii—Oleoresin of Aspidium.—*Dose*, ¼–1 fluidram (1.0–4.0 Cc.) [30 grains (2 Gm.), U. S. P.].

NOTE.—Oleoresin of aspidium usually deposits, on standing, a granular crystalline substance. This should be thoroughly mixed with the liquid portion before use. The oleoresin should be kept in well-stoppered bottles.

Physiological Action and Therapeutics.—Aspidium is the most reliable *tæniacide* known to materia medica. Though it is employed against both the armed and unarmed varieties of tapeworm, it is nevertheless against the latter that it is specially effective. In the cases of armed tæniæ special precautions must be taken to ensure success.

The drug possesses tonic and astringent properties, and if taken in very large doses may occasion nausea, vomiting, diarrhea, and gastric and abdominal pains.

Several fatal cases of poisoning have occurred by reason of unlooked-for causes permitting absorption. The symptoms have been long in developing, and consist of pain, nausea, vomiting, occasionally icterus, confusion, clouding of consciousness, blindness, great muscular depression, trismus, mydriasis, collapse, coma, and death after a few days.

When given for the expulsion of tapeworm the bowels should first be emptied by a castor-oil purge, and then the oleoresin be administered in gelatin capsules or in emulsion.

Blindness has been a permanent effect on recovery from poisoning in some cases. 120 grains (8 Gm.) have been fatal for a child and 43 Gm. of root for an adult.

Previous to the exhibition of the anthelmintic the patient should live on exceedingly spare diet for at least twenty-four hours, and the medicine then be given in the morning fasting. A few hours later an active purge of about 1 ounce (30.0 Cc.) of castor oil or calomel and jalap should be given to expel the dead worm, which should be carefully examined for the head. If the head does not pass, the treatment should be repeated the following day or soon after.

Cŭsso—Cŭsso—Kousso. *U. S. P.*

(BRAYERA.)

Definition.—The dried pannicles of the pistillate flowers of *Hagenia abyssinica* (Bruce) Gmelin, a handsome tree, 40 to 50 feet (12–18 M.) high, indigenous on the table-land and in the mountainous districts of Abyssinia.

Description and Properties.—In bundles, rolls, or compressed clusters consisting of panicles about 10 inches (25.0 Cm.) long, with a sheathing bract at the base of each branch; the two roundish bracts at the base of each flower and the four or five obovate outer sepals are of a reddish color, membranous and veiny; calyx top-shaped, hairy, enclosing two carpels or nutlets; odor slight, fragrant, and tea-like; taste bitter, acrid, and nauseous.

It contains an active principle, kosotoxin, a tasteless and an acid resin, and about 24 per cent. of tannin.

Dose.—1–4 drams (4.0–16.0 Gm.) [240 grains (16 Gm.), U. S. P.].

Physiological Action and Therapeutics.—The action of kousso upon the digestive tract, under large doses, is similar to the action of aspidium. It is a reliable anthelmintic for all species of tape-worm. The fluidextract should be given in the form of an emulsion, the patient having previously fasted, and the exhibition of the drug followed in a few hours by a large dose of castor oil. Nausea, vomiting, diarrhea, and collapse may develop after large doses.

Granātum—Granāti—Pomegranate. *U. S. P.*

Origin.—The bark of the stem and root of *Punica Granatum* L., a shrub or small tree about 20 feet (6 M.) high, indigenous in Southwestern Asia from Northern India to Palestine.

Description and Properties.—In thin quills or fragments from 2 to 4 inches (5–10 Cm.) long and from $\frac{1}{25}$ to $\frac{1}{8}$ inch (1–3 Mm.) thick; outer surface yellowish gray, somewhat warty or longitudinally and reticulately ridged; the stem-bark often partly covered with blackish lichens; the thicker pieces of the root-bark more or less scaly externally; inner surface smooth, finely striate, grayish yellow; fracture short, granular, greenish yellow, indistinctly radiate; inodorous; taste astringent, very slightly bitter.

It contains as its active constituent a liquid alkaloid, *pelletierine*, with its three allied alkaloids, *methylpelletierine*, *pseudopelletierine*, and *isopelletierine*, besides mannite and punico-tannic acid.

Dose.—½–1½ drams (2.0–6.0 Gm.) [30 grains (2 Gm.), U. S. P.].

Preparations.

Pelletierinæ Tănnas—Pelletierinæ Tannātis—Pelletierine Tannate (U. S. P.).—*Definition.*—A mixture in varying proportions of the tannates of four alkaloids (punicine, isopunicine, methylpunicine, and pseudopunicine) obtained from *Punica granatum* (pomegranate).

Also known as punicinum tannicum. The alkaloids are also known as pelletierine, isopelletierine, etc.

Description.—A yellowish-white, odorless, amorphous powder, having an astringent taste, and a weak acid reaction. Soluble in water (1 : 235), alcohol (1 : 12.6), and in warm dilute acids.

Dose.—Average dose: 4 grains (0.250 Gm. = 250 Mg.), U. S. P..

The pelletierines of commerce seem to vary greatly; some are ten times as poisonous as others. While the U. S. Pharmacopœia names, as the average dose of the tannate, 4 grains (0.25 Gm.), some writers recommend 10–20 grains (0.75–1.5 Gm.). Very unpleasant effects are said to have resulted from 2.5–7.5 grains (0.4–0.5 Gm.).

Fluidextractum Granati—Fluidextracti Granati—Fluidextract of Pomegranate (U. S. P.).—*Definition.*—Hitherto only the bark of the stem and root of *Granatum* (pomegranate) has been official; it was often administered in the form of a decoction (official in the Br. P.), but this was very unpleasant to take, owing to the large amount of tannic acid present. A mixture of the tannates of the most important active constituents (four alkaloids) of granatum has also been introduced under the name *Pelletierinæ Tannas* (q. v.).

Dose.—Average dose: 30 minims (2 Cc.), U. S. P.

Physiological Action and Therapeutics.—Locally pomegranate is astringent. In large doses it excites vomiting, acts as a purgative, paralyzes the motor nerves, but does not affect sensation, and dilates the capillaries.

Poisonous symptoms usually begin with severe headache, giddiness, chilly sensations, and rise in temperature. There is mydriasis and collapse, with nausea and vomiting. Blindness has been known to occur and to persist for some time.

Pomegranate and its alkaloid, pelletierine, are efficient anthelmintics for tapeworm.

Like other anthelmintics, the drug should be given on an empty stomach, and if the bowels are not freely moved by the remedy, an active cathartic should follow its administration.

A decoction of the bark may be used, but, owing to the difficulty in obtaining the fresh drug, which alone possesses anthelmintic properties, the tannate of pelletierine, which is always reliable, is usually administered.

Pēpo—Pepōnis—Pumpkin Seed. *U. S. P.*

Origin.—The ripe seed of *Cucurbita pepo* L., the common pumpkin, indigenous in tropical Asia and America, and cultivated throughout the temperate zones.

Description and Properties.—About ¾ inch (2 Cm.) long, broadly-ovate, flat, white or whitish, nearly smooth, with a shallow groove parallel to the edge; containing a short, conical radicle and two flat cotyledons; inodorous; taste bland and oily. It contains an *acrid resin*, supposed to be the active principle, and from 30 to 35 per cent. of a thick red fixed oil.

Dose.—1–3 ounces (32.0–94.0 Gm.) [1 ounce (30 Gm.), U. S. P.].

Physiological Action and Therapeutics.—Pumpkin seed ranks next to aspidium in the minds of some therapeutists as a remedy for the destruction of *tapeworm*, and has the advantage of being free from any disagreeable taste or unpleasant action. For administration the fresh pumpkin seeds should be beaten into a paste with powdered sugar and diluted with milk or water to about 1 pint (500 Cc.). Previous to its administration the patient should fast for twenty-four hours, when the bowels should be flushed out with a large saline purgative. A portion of the emulsion of pumpkin seed is then to be taken, preferably in the morning, and the balance taken in two doses at intervals of about two hours, the patient meanwhile remaining in bed to prevent, as far as possible, disturbance of the stomach.

DRUGS ACTING ON THE RESPIRATORY MUCOUS MEMBRANES.

EXPECTORANTS.

EXPECTORANTS are drugs which stimulate, depress, or modify the secretion from the bronchial or laryngeal mucous membranes and promote its expulsion.

There are many drugs not classed as expectorants which, under certain conditions, may be used to serve one of these purposes. Thus, opium and chloral, by the depressing influence which they exert upon the respiratory center and the reflex mechanism, may relieve reflex and purposeless cough, or, as is the case with the former drug, check excessive secretion or render it more viscid.

Demulcents, such as gum acacia, flaxseed, elm, etc., and other drugs like potassium chlorate, sodium chloride, etc., either lessen or excite the tracheal and bronchial cilia, retarding or promoting expectoration of bronchial mucus. The classification usually adopted seems to be the most reasonable—viz., that of dividing expectorants into two classes: 1. Nauseant or Sedative. 2. Stimulating. Among the more important Nauseant or Sedative Expectorants[1] are:

* Alkalies;
* Antimony and potassium tartrate (tartar emetic);
* Apomorphine;
Grindelia;
* Ipecacuanha;
* Lobelia;
* Pilocarpus;
* Potassium iodide;
* Quebracho;

all of which are considered in detail elsewhere.

The important Stimulating Expectorants are:

* Acids;
* Ammonium carbonate;
Ammonium chloride;
* Balsam of Peru;
* Balsam of Tolu;
* Benzoin and benzoic acid;
* Copaiba;
* Cubeb;
* Garlic;
Licorice;
* Nux vomica (Strychnine);
* Oil of Scotch fir (oleum pini sylvestris);
* Oleum pini pumilionis;
* Onion;
* Saccharine substances;
Sanguinaria;
* Senega (saponin);
* Sulphur;
* Squill;
* Tar;
* Terebene;
* Terpin hydrate;
* Turpentine;
* Volatile oils in general.

[1] (Those marked with an asterisk (*) are elsewhere given in detail.)

As a rule, Sedative Expectorants are permissible only in acute stages of bronchitis, when, as in the case in the beginning of all catarrhal inflammations, there is complete or partial suspension of function, absence of secretion, and much irritation in the bronchi, with distressing, harsh, and dry cough.

In these conditions of the respiratory passages the nauseating sedative expectorants serve a useful purpose in lowering arterial tension, lessening the blood-supply to the inflamed parts, and increasing the secretion of mucus.

In sufficiently large doses to produce emesis the same expectorants are frequently employed to expel an accumulation of mucus mechanically by the act of vomiting.

Stimulating expectorants are more serviceable in chronic and relaxed conditions of the mucous membrane. They are usually employed to diminish or disinfect an abnormally increased secretion. These remedies generally increase blood-pressure and facilitate expectoration, being eliminated to a great extent by the mucous membranes which they stimulate.

The alkalies are especially useful in lessening the viscidity of mucus, rendering it more fluid, less tenacious, and therefore more easily expelled.

It requires considerable skill to combine expectorants so as to best suit the various conditions found in practice. The diseases of the respiratory passages gradually merge, so that in the treatment of them it is often difficult to decide which remedy will be of more service, a sedative or a stimulant expectorant. The physician should carefully examine each individual case and decide whether he wishes to diminish or increase the blood-supply to the respiratory tract; to stimulate or depress the respirations; to overcome spasm of the bronchial muscles; to diminish, increase, or disinfect the bronchial secretion.

A thorough knowledge of the patient's condition and of the physiological action of the various remedies at command will enable the observant practitioner to combine expectorants in such manner as to yield ordinarily highly satisfactory results.

Ammōnii Chlōridum—Ammōnii Chlōridi—Ammonium Chloride. *U. S. P.*

Origin.—Ammonium sulphate is first formed by neutralizing gas liquor with sulphuric acid. After crystallization sublime with sodium chloride.

Description and Properties.—A white, crystalline powder, without odor, having a cooling, saline taste, and permanent in the air. Soluble in two parts of water; almost insoluble in alcohol.

Dose.—1–30 grains (0.06–2.0 Gm.) [7½ grains (0.5 Gm.), U. S. P.].

Official Preparation.

Trochĭsci Ammōnii Chlōridi—Trochĭscos (acc.) Ammōnii Chlōridi—Troches of Ammonium Chloride.—Each troche contains 1.5 grains (0.10 Gm.).—*Dose*, 1–6 troches.

Antagonists and Incompatibles.—Therapeutically, ammonium chloride is antagonized by the cardiac depressants. The incompatibles are—alkalies, alkaline earths and their carbonates, tartaric acid, mineral acids, and the soluble lead and silver salts.

Synergists.—The expectorants, emetics, and diaphoretics enhance the action of the drug.

Physiological Action.—*Externally and Locally.*—Ammonium chloride is an irritant.

Internally.—In medicinal doses the drug increases the secretions from the gastro-intestinal glands. Ammonium chloride is readily absorbed, and is eliminated by the kidneys, skin, bronchi, and mucous membranes generally, the drug being a feeble diuretic, diaphoretic, and expectorant.

Save uric acid, which is slightly diminished, all the solids of the urine are increased under the use of ammonium chloride. The drug is not considered poisonous.

Therapeutics.—*Externally and Locally.*—AMMONIUM CHLORIDE possesses a wide range of therapeutic applications. Solutions of various strengths have proved markedly efficient as local applications in *indolent buboes*, *epididymitis*, *orchitis*, *bruises*, *inflammatory swellings*, *suppurative mastitis*, etc. *Senile gangrene* is much benefited by immersing the foot in a bath containing 8 ounces (249.0 Gm.) of the drug to 1 gallon of water.

A solution of 3 drams (12.0 Gm.) of ammonium chloride to 1 pint (473.17 Cc.) of water is an efficient remedy in *vaginitis*. The lotion may be used as an injection or a tampon saturated with the fluid and applied to the parts.

LOZENGES, SOLUTIONS, or the NASCENT FUMES of the drug have been found serviceable in many diseases of the *nose*, *throat*, and *ear*, such as *coryza*, *chronic laryngitis* and *pharyngitis*, *chronic aural catarrh*, etc.

Internally.—Few remedies are more efficient than AMMONIUM CHLORIDE in *bronchitis* that has passed its inflammatory stage. In *chronic bronchitis*, particularly that form occurring in old people and persons of a feeble habit of body, the drug is very valuable, either given alone or associated with stimulant expectorants. The remedy has appeared to be somewhat beneficial in *whooping-cough*.

Contraindications.—Inflammation of the stomach, aggravated dyspepsia, marked emaciation, and anemia contraindicate the drug.

Administration.—Ammonium chloride is best given in solution, its disagreeable taste being well disguised by the addition of some preparation of licorice, such as the syrup, fluidextract, or the aromatic elixir of licorice. In bronchial diseases the virtues of the drug are enhanced by this association.

Glycyrrhīza—Glycyrrhīzæ—Glycyrrhiza. *U. S. P.*

(LIQUORICE ROOT.)

Origin.—The dried root of *Glycyrrhiza glabra* L., or of *Glycyrrhiza glandulifera* (Waldstein et Killaibel), a perennial plant indigenous in the countries lying on

the northern and southern shores of the Mediterranean and farther east through the Caucasus, Northern Persia, Afghanistan, and Southern Siberia to China, and cultivated to some extent in England, France, Germany, and the United States.

Description and Properties.—In long, cylindrical pieces, from ¼ to 1 inch (6–25 Mm.) thick, longitudinally wrinkled, externally grayish-brown, warty; internally tawny yellow, pliable, tough; fracture coarsely fibrous; bark rather thick; wood porous, but dense in the narrow wedges; medullary rays linear; taste sweet, somewhat acrid. The underground stem, which is often present, has the same appearance, but contains a thin pith.

The drug derived from the *G. glandulifera* (so-called Russian liquorice) consists usually of roots or root branches 1–4 inches (2–10 Cm.) thick and 8–12 inches (15–30 Cm.) long, frequently deprived of the corky layer, the wood rather soft and usually more or less cleft.

Liquorice contains a glycoside, *glycyrrhizin*, besides asparagin, glycyramarin, an acrid resin, starch, gum, etc.

Dose.—15–60 grains (1–4 Gm.) [30 grains (2 Gm.), U. S. P.].

Official Preparations.

Fluidextrăctum Glycyrrhīzæ—Fluidextrăcti Glycyrrhīzæ—Fluidextract of Glycyrrhiza.—*Dose*, 15–60 minims (1.0–4.0 Cc.).

Extrăctum Glycyrrhīzæ—Extrăcti Glycyrrhīzæ—Extract of Glycyrrhiza.—*Dose*, freely. (Extract of glycyrrhiza is contained in trochisci ammonii chloridi and trochisci glycyrrhizæ et opii.)

Extrăctum Glycyrrhīzæ Pūrum—Extrăcti Glycyrrhīzæ Pūri—Pure Extract of Glycyrrhiza.—*Dose*, freely.

Glycyrrhizīnum Ammoniātum—Glycyrrhizīni Ammoniāti—Ammoniated Glycyrrhizin.—*Description and Properties.*—Dark-brown or brownish-red scales, without odor and having a very sweet taste; readily soluble in water and alcohol.

Dose.—5–15 grains (0.3–1.0 Gm.) [4 grains (0.25 Gm.), U. S. P.].

Mistūra Glycyrrhīzæ Compŏsita—Mistūra Glycyrrhīzæ Compŏsitæ—Compound Mixture of Glycyrrhiza (BROWN MIXTURE).—Formula: Pure extract of glycyrrhiza, 30; syrup, 50; acacia, 30; camphorated tincture of opium, 120; wine of antimony, 60; spirit of nitrous ether, 30; water, to 1000.

Dose.—1–4 fluidrams (4.0–15.0 Cc.) [2 fluidrams (8 Cc.), U. S. P.].

Pūlvis Glycyrrhīzæ Compŏsitus—Pūlveris Glycyrrhīzæ Compŏsiti—Compound Powder of Glycyrrhiza.—(See *Senna*.)

Besides the foregoing compounds, glycyrrhiza forms an ingredient of eleven other official preparations.

Physiological Action and Therapeutics.—The drug when chewed increases the flow of saliva. It is demulcent and laxative, and possesses slight stimulating properties when locally applied. It favors the secretions of the congested mucous membrane of the respiratory passages.

LIQUORICE is used chiefly for its demulcent properties in *sore throat, hoarseness, pharyngeal cough, acute bronchitis*, etc. It has no general action. It is nothing more than a pleasant-tasting demulcent, but, being so frequently combined with cough mixtures, has acquired a vicarious reputation as an expectorant. The compound mixture is a very efficient remedy in bronchitis.

The various preparations of liquorice are serviceable in concealing the taste of nauseous and bitter medicines and as an excipient for pills.

Administration.—There are no special directions to be given—any of the preparations may be used.

Sĕnega—Sĕnegæ—Senega. *U. S. P.*

Origin.—The dried root of *Polygala Senega* L., a plant indigenous in North America, from Canada southward to South Carolina and westward to Wisconsin.

Description and Properties.—About 4 inches (10 Cm.) long, with a knotty crown and spreading, tortuous branches, peeled when dry, fleshy and round after having been soaked in water; externally yellowish-gray or brownish-yellow; bark thick, white within, enclosing an irregular, porous, yellowish wood; odor slight, unpleasant; taste sweetish, afterward acrid. Senega contains *senegin*, also known as saponin, an acrid principle to which the medicinal property of the drug is due, besides a fixed and a volatile oil.

Dose.—10–30 grains (0.6–2.0 Gm.) [15 grains (1 Gm.), U. S. P.].

Official Preparations.

Fluidextrăctum Sĕnegæ—Fluidextrăcti Sĕnegæ—Fluidextract of Senega.—*Dose*, 10–30 minims (0.6–2.0 Cc.) [15 minims (1 Cc.), U. S. P.].

Sȳrupus Sĕnegæ—Sȳrupi Sĕnegæ—Syrup of Senega (20 per cent. of fluidextract).

Dose.—30–60 minims (2.0–4.0 Cc.) [1 fluidram (4 Cc.), U. S. P.].

Sȳrupus Scĭllæ Compŏsitus—Sȳrupi Scĭllæ Compŏsiti—Compound Syrup of Squill (contains 8 per cent. of senega). (Described under *Scilla.*)

Physiological Action.—*Externally and Locally.*—The active principle of senega is a decided irritant to the skin and mucous membranes, causing violent sneezing and cough, with marked hydremia and increased secretion from the bronchial and nasal mucous membranes when the powder is inhaled.

Internally.—Digestive System.—Small doses stimulate the mucous membranes of the mouth and stomach, augmenting the salivary and gastric secretions, although frequently occasioning indigestion. Large doses irritate the alimentary canal, producing vomiting, diarrhea, and abdominal pain.

Circulatory System.—Small doses have little action.

Nervous System.—Under medicinal doses no important action has been noted.

Respiratory System.—Excretion of the drug through the bronchial mucous membrane irritates the respiratory passages, occasioning hyperemia, increased secretion, and, reflexly, cough.

Absorption and Elimination.—The active principle of senega is absorbed with difficulty, being excreted through the bronchial mucous membrane and the kidneys, irritating these structures during the process, and consequently acting as a stimulant, expectorant, and diuretic. The drug also possesses some diaphoretic virtue, being partially excreted by the skin.

Untoward Action.—Immoderate, and in certain susceptible subjects small, doses of senega have produced irritation and burning in the throat, salivation, impaired appetite, a sense of oppression in the stomach, nausea, vomiting, colicky pains, and profuse diarrhea.

Poisoning.—Senega is not regarded as a poisonous drug, excessive doses producing symptoms analogous to those of "Untoward Action," save that they are intensified. It should be remembered, however, that saponin and sapotoxin, which are found in senega, as also is sarsaparilla, quillaja, caulophyllum, and dulcamara are very

active blood poisons and may cause rapidly fatal poisoning. The saponins are common, moreover, in the solanaceous plants, and are responsible for poisoning from unripe tomatoes, sprouting potatoes, and egg-plant.

Treatment of Poisoning.—Elimination is to be favored, and the symptoms treated as they appear, gastric, sedatives, anodynes, and cardiac stimulants being employed.

Therapeutics.—*Externally and Locally.*—No action has been observed.

Internally.—The principal use of SENEGA is that of a stimulating expectorant. It is highly beneficial in *subacute bronchitis* when the power to cough is feeble. In like manner senega is useful in *bronchorrhea* and *chronic bronchitis* with profuse expectoration, though less valuable when the mucus is tough and scanty.

The simple *catarrhal laryngitis* following *croup* is greatly relieved by the administration of senega.

The drug is an appropriate remedy in *amenorrhea* the result of passive uterine congestion, and SENEGIN has been recommended as a remedy for *uterine hemorrhage.*

Contraindications.—Senega is inadmissible in acute bronchitis and indigestion, or when there is marked irritation and inflammation of the gastro-intestinal tract.

Administration—The syrup of senega is the preparation usually employed as an expectorant. Senegin may be given in doses of 2 grains (0.13 Gm.) in capsules.

Sanguināria—Sanguināriæ—Sanguinaria. *U. S. P.*

(BLOOD-ROOT.)

Origin.—The dried rhizome of *Sanguinaria Canadensis* L., a low perennial, a native of Canada and the United States, where it grows in open woods in a rich soil. The rhizome should be collected in autumn.

Description and Properties.—Of horizontal growth, about 2 inches (5 Cm.) long and ⅜ inch (1 Cm.) thick, cylindrical, somewhat branched, slightly annulate, wrinkled, reddish-brown; fracture short, somewhat waxy, whitish, with numerous small red resin-cells, or of a nearly uniform, brownish-red color; bark thin; odor slight; taste persistently bitter and acrid. It contains a colorless alkaloid, *sanguinarine*, yielding red salts; chelerythine, yielding lemon-yellow salts; homochelidonine; and protopine.

These alkaloids are closely relatad to the opium series.

Dose.—2–20 grains (0.12–1.2 Gm.) [2 grains (0.125 Gm.), U. S. P.].

Official Preparations.

Fluidextrāctum Sanguināriæ—Fluidextrācti Sanguināriæ—Fluidextract of Sanguinaria.—*Dose,* 5–15 minims (0.3–1.0 Cc.) [1½ minims (0.1 Cc.), U. S. P.].

Tinctūra Sanguināriæ (10 per cent.)—**Tinctūræ Sanguināriæ—Tincture of Sanguinaria.**—*Dose,* 10–60 minims (0.6–4.0 Cc.) [15 minims (1 Cc.). U. S. P.].

Physiological Action.—*Externally and Locally.*—Sanguinaria is an irritant and a feeble escharotic. When the powder of blood-root is inhaled it produces great irritation of the respiratory passages, with excessive secretion and violent sneezing.

Internally.—Digestive System.—Medicinal doses occasion a sense of constriction in the throat and heat in the epigastrium, increasing the secretions from the stomach, liver, and intestines. Excessive doses are followed by marked salivation, nausea, and vomiting, the drug acting as a systemic emetic. Very large doses cause great irritation of the intestines, producing hyper-catharsis.

Circulatory System.—At first the heart's action is increased and arterial tension raised, but these effects are followed by cardiac and circulatory depression. Poisonous doses sometimes result in cardiac paralysis.

Nervous System.—Large doses diminish reflex excitability by paralysis of the spinal centers, occasionally producing convulsions of spinal origin, resembling those caused by thebaine.

Respiratory System.—Medicinal doses of sanguinaria have no apparent effect upon the respiration; poisonous doses, however, render the breathing slow and shallow, death resulting from asphyxia due to paralysis of the respiratory center. The final collapse is often preceded by convulsions arising from the accumulation of carbon dioxide in the blood from failure of respiration.

Blood-root is a stimulant expectorant, increasing the secretion from the bronchopulmonary mucous membrane.

Poisoning.—Blood-root is an acrid narcotic poison, exciting salivation, violent vomiting, profuse watery evacuations from the bowels, and producing all the symptoms of gastro-enteritis. The muscular system is greatly relaxed, the pulse is slow, weak, and irregular, the skin covered with cold sweat, and finally, collapse of the vital powers supervenes. Convulsions may precede a fatal termination, which is due to paralysis of the respiratory or cardiac center.

Treatment of Poisoning.—The stomach should be washed out and diffusible stimulants freely given. Strychnine may be administered hypodermically, and digitalis and amyl nitrite given if necessary. The pain and nausea may be relieved by morphine and atropine. The normal temperature of the body should be maintained by external warmth.

This drug is now seldom used locally, the irritation caused by it being so great that patients can only with great difficulty be persuaded to submit to the treatment.

Internally.—While possessing alterative properties and classed among the specifics, one of the principal uses of sanguinaria is in *acute bronchitis*, when the spasmodic element predominates and after the subsidence of the more acute symptoms.

In atonic conditions of the *stomach* and *bowels*, with increased secretion of mucus, small doses of tincture of sanguinaria prove beneficial. The tincture is of equal value in *duodenal catarrh* with jaundice.

As an emmenagogue and aphrodisiac blood-root has been successfully employed in *functional amenorrhea* and *dysmenorrhea*, as

well as in functional *impotence* with *relaxation* of the *genital organs* and daily *seminal losses*.

Contraindications.—No special contraindication exists, unless it be an acute inflammatory condition of the stomach and bowels.

Sanguinaria has practically gone out of use, as it is too irritating and "old fashioned" a drug.

Bălsamum Tolutānum—Bălsami Tolutāni—Balsam of Tolu. *U. S. P.*

Origin.—A balsam obtained from *Toluifera Balsamum* L., an evergreen tree from 60 to 80 feet (18–24 M.) high, growing in the high rolling country of Venezuela and New Granada.

Description and Properties.—A yellowish-brown, semifluid, or nearly solid mass, becoming more brittle when exposed to cold; transparent in thin layers, having an agreeable odor, recalling that of vanilla, but distinct from it, and a mild, aromatic taste; readily and completely soluble in alcohol, chloroform, and solutions of the fixed alkalies; almost wholly soluble in ether, but nearly insoluble in water or carbon disulphide.

The drug contains a volatile oil (chiefly toluene), cinnamic and benzoic acids, and a resin.

Dose.—8–30 minims (0.5–2.0 Cc.) [15 grains (1 Gm.), U. S. P.].

Official Preparations.

Sȳrupus Tolutānus—Sȳrupi Tolutāni—Syrup of Tolu (0.5 per cent.).—*Dose*, 2–6 fluidrams (8.0–24.0 Cc.) [4 fluidrams (16 Cc.), U. S. P.].

Tinctūra Tolutāna—Tinctūræ Tolutānæ—Tincture of Tolu (20 per cent.).—*Dose*, ½–2 fluidrams (2.0–8.0 Cc.) [30 minims (2 Cc.), U. S. P.].

Tinctūra Benzoīni Compŏsita—Tinctūræ Benzoīni Compŏsita—Compound Tincture of Benzoin (4 per cent.).—Described under *Benzoin*.

Antagonists and Incompatibles.—Aqueous preparations are pharmaceutically incompatible with the tincture of tolu.

Synergists.—The balsams, aromatic drugs, volatile oils, and stimulant expectorants.

Physiological Action.—Balsam of tolu is antiseptic, disinfectant, and stimulant when applied to the skin and to raw surfaces. It is a pleasant carminative and stomachic.

The drug is excreted principally by the mucous membranes, the secretions from which it stimulates and disinfects. The skin and kidneys also share in the excretory process.

Therapeutics.—Inhalations of the vapor of tolu have been successfully employed in the treatment of *chronic pharyngitis*, and a pigment composed of 1 part of tolu to 5 parts of ether or alcohol has been beneficially applied to *diphtheritic deposits* on the tonsils and pharynx.

Its agreeable flavor, together with its stimulating and expectorant properties, renders tolu an efficient and agreeable ingredient of cough mixtures, lozenges, vapors, etc., employed to modify the course of *subacute* and *chronic bronchitis*.

Administration.—Tolu is usually administered in the form of syrup, although the tincture may be given in emulsion. Inhalations of tolu vapor are employed, and lozenges containing tolu are frequently used.

Pĭx Lĭquida—Pĭcis Lĭquidæ—Tar. *U. S. P.*

Definition.—A product obtained by the destructive distillation of the wood of *Pinus palustris* Miller, and other species of *Pinus*.

Description and Properties.—Thick, viscid, semifluid, blackish-brown, heavier than water, transparent in thin layers, becoming granular and opaque with age; odor empyreumatic, terebinthinate; taste sharp, empyreumatic. Tar is slightly soluble in water; soluble in alcohol, fixed and volatile oils, and solution of potassium or sodium hydrate.

The drug contains many substances, chief among which are empyreumatic volatile oil, pyrocatechin, acetone, xylol, toluol, cresols (creasote), guaiacol, phenol, etc.

Dose.—15–60 grains (1.0–4.0 Gm.) [7½ grains (0.5 Gm.), U. S. P.].

Official Preparations.

Sȳrupus Pĭcis Lĭquidæ—Sȳrupi Pĭcis Lĭquidæ—Syrup of Tar (0.5 per cent.).—*Dose*, 1–4 fluidrams (4.0–15.0 Cc.) [1 dram (4 Cc.), U. S. P.].

Unguĕntum Pĭcis Lĭquidæ—Unguĕnti Pĭcis Lĭquidæ—Tar Ointment (50 per cent.).—Used externally.

Ōleum Pĭcis Lĭquidæ—Ōlei Pĭcis Lĭquidæ—Oil of Tar (U. S. P.).—*Origin.*—A volatile oil distilled from tar.

Description and Properties.—An almost odorless liquid when freshly distilled, but soon acquiring a dark reddish-brown color, and having a strong tarry odor and taste. It is readily soluble in alcohol.

Dose.—1–5 minims (0.065–0.3 Cc.) [3 minims (0.2 Cc.), U. S. P.].

Derivatives and Allied Drugs.

Pĭxol.—A compound of tar soap and caustic potash or soda. Used as a disinfectant and antiseptic.

Pĭx Bĕtulæ—Pĭcis Bĕtulæ—Birch Tar (Oleum Rusci).—*Origin.*—Prepared in Russia from the wood and bark of *Betula alba* L.

Description and Properties.—Resembling wood-tar in appearance, but remaining liquid, and having the peculiar penetrating odor of Russia leather, in the manufacture of which it is used. For the most part employed externally.

Ōleum Cadĭnum—Ōlei Cadĭni—Oil of Cade (U. S. P.).—*Origin.*—A product of the dry distillation of the wood of *Juniperus Oxycedrus* L.

Description and Properties.—An empyreumatic, brownish or dark-brown, clear, thick liquid, possessing a tarry odor and an empyreumatic, burning, somewhat bitter taste. Almost insoluble in water; partially soluble in alcohol.

Dose.—2–6 minims (0.12–0.3 Cc.). Chiefly used externally.

Antagonists and Incompatibles.—There are none of special importance.

Synergists.—The aromatics, carbolic acid, creasote, and many of the antiseptics, turpentine, and the stimulant expectorants.

Physiological Action.—*Externally and Locally.*—Tar is a stimulant, astringent, antipruritic, antiseptic, and parasiticide. It is readily absorbed from the skin, and when applied too freely may produce a papular eruption.

Internally.—The action of tar closely resembles that of turpentine, although creosote is perhaps a more perfect analogue. Small doses stimulate the circulation and increase secretions generally. Immoderate dosage or the prolonged administration of tar impairs the appetite, deranges digestion, and depresses the circulatory and nervous systems.

While the drug is not considered poisonous, the ingestion of excessive quantities of oil of tar has been attended with fatal results.

The symptoms following imprudent dosage are nausea, vomiting, severe abdominal pain, diarrhea, headache, and dizziness. The urine is colored blackish-brown, and may contain blood or albumin and emit the peculiar odor of tar. There may be present erythema, or the skin may be covered with papules or vesicles attended with intense itching.

Therapeutics.—*Externally and Locally.*—With the possible exception of sulphur and mercury, TAR is the most universally employed remedy for cutaneous diseases, the drug having for centuries held an important place among the efficient topical agents in the treatment of *diseases of the skin*, *unhealthy ulcers*, *fissured nipples*, *boils*, *excoriations*, etc.

In *chronic eczema* the drug is peculiarly servicable, and it has proved beneficial in *chronic psoriasis* and *scabies.*

The OIL OF CADE and OIL OF BIRCH are used for the same purposes as tar, being preferred by some expert dermatologists. The tarry preparations are valuable antipruritics, and of service in *pruritus* and various itching diseases of the skin, although their tendency to produce irritative and inflammatory effects when continuously and injudiciously applied should not be overlooked.

The benign and emollient effects of TAR are best obtained when the drug is mixed with some soothing or astringent powder, such as chalk.

The valuable properties of tar in the treatment of cutaneous diseases are often nullified by the ignorance of the physician and lack of proper administration of the drug. Prof. James Nevins Hyde has truthfully observed that "the skill of a physician entrusted with the management of a disease of the skin might also be measured by his success in the use of tar."

LOZENGES containing tar, the VAPOR OF OIL OF TAR, and sprays containing tar are extensively employed in the treatment of various *diseases of the nose* and *throat.*

Internally.—TAR has long possessed an enviable reputation as a remedy for chronic pulmonary complaints, being very efficient in the treatment of *chronic bronchitis* and the advanced stages of obstinate *acute bronchitis*, lessening the expectoration, allaying the oppression and distress in the chest, and soothing the cough. These symptoms, which attend many cases of *pulmonary phthisis*, are frequently relieved by some preparation of tar.

Not only is this remedy of value in catarrhal conditions of the respiratory passages; it is equally efficient in similar conditions of mucous membranes elsewhere. Thus TAR WATER has been employed with great benefit in *gleet*, *leukorrhea*, *vesical catarrh*, etc., being given both by the mouth and in the form of an injection.

Administration.—Tar may be given in milk or beer or in pill form, although the most palatable forms are the syrup, glycerite, wine, and tar water, the last of which may be given to the extent of 1 or 2 pints (473.17 or 946.35 Cc.) daily.

Terebēnum—Terebēni—Terebene. *U. S. P.*

Definition.—A liquid consisting chiefly of dipentene and other hydrocarbons, obtained by the action of concentrated sulphuric acid in oil of turpentine and subsequent rectification with them.

Description and Properties.—A colorless or slightly yellowish, thin liquid having rather an agreeable thyme-like odor and an aromatic, somewhat terbinthinate taste. Only slightly soluble in water, but soluble in an equal volume of alcohol. Terebene should be kept in well-stoppered bottles, in a cool place protected from light.

Dose.—5–15 minims (0.3–1.0 Cc.) [8 minims (0.5 Cc.), U. S. P.].

Physiological Action.—When applied externally terebene acts as a stimulant, germicide, antiseptic, and astringent. Internally, small doses act as a stimulant to the gastro-intestinal tract, large amounts being irritant and producing effects similar to those of turpentine.

The drug is eliminated by the kidneys, bronchial mucous membranes, skin, bowels, etc., acting as a mild astringent and antiseptic at the points of elimination.

Therapeutics.—*Externally and Locally.*—The inhalation of terebene—20 minims (1.23 Cc.) daily—allays the cough of *laryngeal phthisis* and has proved beneficial in irritative *bronchial cough*, while a spray of terebene mixed with oil of eucalyptus and alcohol has been advised in *whooping-cough*.

Internally.—Whether inhaled or taken into the stomach, terebene is a powerful stimulant, antiseptic expectorant in *chronic bronchitis*.

The drug is of service in affections of either the upper or lower respiratory passages. In *winter-cough*, *bronchorrhea*, *emphysema*, and even in *phthisis*, it is an efficient remedy.

Not only in bronchial affections is the drug valuable, but it has been used with striking success as a substitute for copaiba and oil of sandalwood in *genito-urinary diseases*. It has even been claimed to influence favorably the course of *puerperal fever* and to relieve the symptoms of *flatulent dyspepsia*.

Administration.—Terebene may be given in emulsion or in mixtures associated with other expectorants and enclosed in capsules or dropped upon sugar.

Terpīni Hȳdras—Terpīni Hydrātis—Terpin Hydrate. *U. S. P.*

Origin.—The hydrate of the diatomic alcohol terpin, prepared by mixing rectified oil of turpentine, alcohol, and nitric acid, allowing the mixture to stand for three or four days in shallow porcelain dishes, collecting the crystals which have formed, drying on absorbent paper, and recrystallizing in a cold solution of alcohol.

Description and Properties.—Colorless, lustrous, rhombic prisms, nearly odorless, and having a slightly aromatic and somewhat bitter taste. Permanent in the air. Soluble in about 250 parts of water and in 10 parts of alcohol. Terpin hydrate should be kept in well-stoppered bottles.

Dose.—2–30 grains (0.12–2.0 Gm.) [2 grains (0.125 Gm.), U. S. P.].

Physiological Action.—Terpin hydrate is a powerful antiseptic, its action resembling that of turpentine, though inferior in strength.

Therapeutics.—*Externally and Locally.*—The drug is used in the form of lozenges and as an inhalant in *chronic tracheitis* and *chronic bronchitis.*

Internally.—Terpin hydrate may be used for the same purposes as terebene, being considered by some physicians superior to the latter drug in bronchial affections.

Administration.—Terpin hydrate may be given in lozenges, emulsion, or aromatic elixir, although the most judicious method of administration, perhaps, is in capsules.

Allied Compound.

Terpinol is obtained by boiling terpin hydrate with dilute mineral acids. It occurs as an oily body with a hyacinthine odor. Insoluble in water, but readily soluble in alcohol and in ether.

Terpinol is a valuable bronchial stimulant, and may be used for the same diseases of the respiratory passages for which terpin hydrate is recommended.

It is best given in capsules, in doses of about 2 grains (0.12 Gm.) each, repeated from four to six times a day.

DRUGS ACTING PARTICULARLY ON THE UTERUS.

EMMENAGOGUES AND ECBOLICS.

EMMENAGOGUES are remedies which restore or increase the menstrual flow. They are divided, according to their action, into two classes. Those which act upon the uterine muscle or mucous membrane are said to be *direct;* those which influence the uterus by affecting the general health of the body, or by altering the blood-supply of the parts, or by influencing the nervous system, are said to be *indirect.*

The principal Direct Emmenagogues are—

Ergot,	Borax,
Digitalis,	Rue,
Savine,	Hydrastis,
Quinine,	Caulophyllum,
Asafetida,	Tansy,
Myrrh,	Apiol,
Guaiac,	Hedeoma.
Cantharides,	

The Indirect Emmenagogues are—

Iron and the Hematics,	Cinnamon,
Cod-liver Oil,	Aloes.
Strychnine,	

Baths	Hot foot-bath. Hot hip-bath. Mustard bath.
Leeches	To genitals. To thighs.
Mustard	Baths. Poultices to thighs. Stupes.

ECBOLICS or OXYTOCICS are remedies which act directly upon the uterine muscular fibers, inducing uterine contraction, and are chiefly used during or immediately after parturition to produce or increase uterine action. They are, therefore, contraindicated before parturition, lest they induce abortion, although they are often used criminally for this purpose.

The exact manner in which ecbolics act is unknown, but it is

supposed that they act directly by stimulating the uterine center in the cord, or reflexly through uterine congestion.

In small doses many of the ecbolics are emmenagogue, while many of the direct emmenagogues are ecbolic.

The only justifiable uses for ecbolics are in parturition, with uterine inertia and unobstructed and well-dilated maternal parts, when it is desired to hasten the delivery of the child, or, second, to induce firm contraction of the uterus, and thus prevent or check uterine hemorrhage after the birth of the child.

The principal Ecbolics are—

Ergot,	Oil of rue,
Ustilago,	Borax,
Hydrastis,	Pilocarpine,
Berberis,	Potassium permanganate,
Savine,	Strong purgatives,
Quinine,	Pennyroyal.
Cotton-root Bark,	

Drugs which have not been considered elsewhere in the present work will be described here:

Sabīna—Sabīnæ—Savine. *U. S. P.*

Origin.—The tops of *Juniperus Sabina* L., a small evergreen procumbent or erect shrub, distributed throughout the greater portion of Europe, Siberia, Canada, and the Northern United States.

Description and Properties.—Short, thin, subquadrangular branchlets; leaves rather dark green, in four rows, opposite, scale-like, ovate-lanceolate, more or less acute, appressed, imbricated, on the back with a shallow groove containing an oblong or roundish gland; odor peculiar, terebinthinate; taste nauseous, resinous, and bitter.

It contains 2 per cent. of a *volatile oil*, tannin, resin, gum, etc.

Dose.—5–15 grains (0.3–1.0 Gm.) [7½ grains (0.5 Gm.), U. S. P.].

Official Preparation.

Fluidextrăctum Sabīnæ—Fluidextrăcti Sabīnæ—Fluidextract of Savine.—*Dose*, 5–15 minims (0.3–1.0 Cc.) [5 minims (3 Cc.), U. S. P.].

Ŏleum Sabīnæ—Ŏlei Sabīnæ—Oil of Savine. *U. S. P.*

Origin.—A volatile oil distilled from the fresh tops of savine.

Description and Properties.—A colorless or yellowish liquid having a pecular terebinthinate odor and a pungent, bitterish, and camphoraceous taste. It becomes darker and thicker by age and exposure to the air. Soluble in an equal volume of alcohol.

Dose.—1–5 minims (0.06–0.3 Cc.) [1 minim (0.05 Gm.), U. S. P.].

Physiological Action and Therapeutics.—The action of savine depends on the presence of the volatile oil, and this oil differs in its local external effect from the oil of turpentine merely in that the oil of savine is more active. It occasions much irritation, vesication, and even pustulation when applied to the skin. Taken

internally in small doses, it produces a sensation of heat in the epigastrium, with flatulence and frequently nausea. Toxic doses excite violent gastro-enteritis.

The drug stimulates the heart's action, and later, under full medicinal doses, depresses it. It is rapidly absorbed, and is excreted by various channels, increasing the urinary and bronchial excretions. These excretions, as well as the sweat and breath, smell strongly of the drug.

Savine is a decided irritant to the uterus and ovaries, inducing marked hyperemia of those organs, and promoting contractions of the pregnant uterus.

Toxic doses produce symptoms similar to those occasioned by oil of turpentine—violent gastro-enteritis, suppressed or bloody urine, great depression, etc. The treatment in poisoning by oil of savine would be full doses of Epsom salt, demulcents, anodynes, and stimulants if necessary.

Savine in the form of an ointment is used as a stimulant application to keep up the discharge from blisters. An alcoholic solution of oil of savine, 5–30 minims (0.3–1.8 Cc.) to 1 ounce (30.0 Cc.), is used in *alopecia pityroides.*

Oil of savine is a very efficient remedy in *amenorrhea,* and is also of benefit in certain cases of *menorrhagia* due to an enlarged and passively congested uterus. The hemorrhage following abortion is usually well controlled by this remedy.

The powder or fluidextract may be given, but the oil is the most effective preparation, and may be prescribed in capsules, pills, or emulsion. It should be given cautiously.

Rūta—Rūtæ—Rue. (*Non-official.*)

Origin.—The leaves of *Ruta graveolens* L., an herbaceous or suffruticose perennial 2 or 3 feet (60 or 90 Cm.) high, indigenous in Southern Europe.

Description and Properties.—The leaves are ternate, the leaflets being obovate-oblong, yellowish-green, thickly dotted with minute, transparent oil-vesicles. They have a peculiar, strongly balsamic odor, and possess an aromatic, bitter, and acrid taste.

The principal constituent of rue is a *volatile oil.*

Dose.—5–20 grains (0.3–1.3 Gm.).

Ōleum Rūtæ—Ōlei Rūtæ—Oil of Rue. (*Non-official.*)

Origin.—A volatile oil distilled from *Ruta graveolens* L.

Description and Properties.—A colorless or greenish-yellow liquid with the peculiar odor of the plant, and a pungent, somewhat acrid, bitterish taste. Soluble in an equal weight of alcohol.

Dose.—2–5 minims (0.13–0.3 Cc.).

Physiological Action and Therapeutics.—The action of oil of rue is analogous to that of oil of savine, though less powerful. It is used for the same purposes also, and has occasionally been employed in *hysteria.*

The oil should be administered in capsules.

Tanacētum—Tanacēti—Tansy. (*Non-official.*)

Origin.—The leaves and tops of *Tanacetum vulgare* L., a perennial herb indigenous in Europe and Central Asia, and naturalized in many parts of North America.

Definition and Properties.—Leaves about 6 inches (15.24 Cm.) long, bipinnatifid, the segments oblong, obtuse, serrate, or incised, smooth, dark green, and glandular; flower-heads corymbose, with an imbricated involucre, a convex, naked receptacle, and numerous yellow tubular florets; odor strongly aromatic; taste pungent and bitter.

It contains a *volatile oil* and a bitter principle, *tenacetin*, besides tannin, resin, etc.

Dose.—15–60 grains (1.0–4.0 Gm.), in infusion.

Physiological Action and Therapeutics.—In moderate doses tansy acts as an aromatic bitter. Excessive amounts produce all the symptoms of an irritant narcotic—vomiting, purging, severe abdominal pain, loss of consciousness, convulsions, and great cardiac and respiratory weakness, death usually resulting from paralysis of respiration.

The drug is regarded as an efficient remedy in *amenorrhea*, and is extensively employed in domestic practice in *hysteria* and *colic*, and topically for *bruises*, *sprains*, *muscular pains*, etc.

It is used in the rural districts to promote or restore *menstruation*, and occasionally is employed with criminal intent as an abortifacient, but usually with negative results.

The drug may be given in the form of an infusion, 1 ounce to 1 pint (32.0 Gm.–473.17 Cc.), of which 1 or 2 fluidounces (30.0 or 60.0 Cc.) may be taken at a dose.

The oil of tansy is occasionally prescribed in doses of 1–5 minims (0.06–0.3 Cc.).

Petroselīnum—Petroselīni—Parsley. (*Non-official.*)

Origin.—The root of *Petroselinum sativum* (Hoffmann), *Apium Petroselinum* L., a plant indigenous in Southern Europe, and much cultivated for culinary purposes.

Description and Properties.—The root is tapering, from 4 to 8 inches (10–20 Cm.) long, about ½ inch (12 Mm.) thick; externally yellowish or light brown; odor aromatic; taste sweetish and aromatic.

It contains a *volatile oil* and *apiol*, the chief constituent.

Dose.—30–60 grains (2.0–4.0 Gm.).

Unofficial Preparation.

Apiŏlum—Apiŏli—Apiol (NON-OFFICIAL).—*Origin.*—A camphor obtained from the fruit of *Petroselinum sativum* Hoffmann.

Description and Properties.—White needles, of a feeble, parsley odor. Insoluble in water, but freely soluble in alcohol and in ether.

Dose.—10–15 grains (0.6–1.0 Gm.).

Physiological Action and Therapeutics.—The root is carminative, laxative, and diuretic. Apiol is an active emmenagogue. Given in excessive doses it occasions severe frontal headache, dizziness, and ringing in the ears. It causes a rapid rise of blood-pressure, due to increased cardiac action and stimulation of the vasomotor centers.

APIOL, or Chapoteaut's APIOLINE, is usually prescribed, and is an efficient remedy in *amenorrhea* and *dysmenorrhea*. As an em-

menagogue in cases of scanty or deficient menstruation APIOLINE is very effective.

Hedeōma—Hedeōmæ—Hedeoma. *U. S. P.*

(PENNYROYAL.)

Origin.—The dried leaves and flowering tops of *Hedeoma pulegioides* (L.) Persoon, an annual herb indigenous in North America.

Description and Properties.—Leaves opposite, short-petioled, about ½ inch (12 Mm.) long, oblong-ovate, obscurely serrate, glandular beneath; branches roundish-quadrangular, hairy; flowers in small, axillary cymules, with a tubular-ovoid, bilabiate, and five-toothed calyx, and a pale-blue, spotted, bilabiate corolla, containing two sterile and two fertile exserted stamens; odor strong, mint-like; taste warm and pungent. Its virtues depend upon a *volatile oil.*

Dose.—15–60 grains (1.0–4.0 Gm.), in infusion [120 grains (8 Gm.), U. S. P.].

Official Preparation.

Ōleum Hedeōmæ—Ōlei Hedeōmæ—Oil of Hedeoma (OIL OF PENNYROYAL).—*Origin.*—A volatile oil distilled from the leaves and flowering tops of Hedeoma.

Description and Properties.—A pale-yellowish, limpid liquid, having a characteristic, pungent, mint-like odor and taste. It should be kept in well-stoppered bottles, in a cool place, protected from light.

Dose.—2–10 minims (0.1–0.6 Cc.) [3 minims (0.2 Cc.), U. S. P.].

Physiological Action and Therapeutics.—Hedeoma is aromatic, stimulant, carminative, and emmenagogue, while the oil is rubefacient if rubbed into the skin.

The herb is given in the form of a HOT INFUSION to bring on retarded or suspended *menstruation* and for the relief of *flatulent colic*, *pharyngitis*, *bronchitis*, etc., as well as to dissipate *congestions* of various parts.

The OIL OF HEDEOMA is an active emmenagogue, and is used to increase the rubefacient effect of various embrocations.

Bĕrberis—Berberīdis—Barberry. *U. S. P.*

Definition.—The rhizome and roots of *Berberis aquifolium* and other species of berberis.

Berberis aquifolium is known as Oregon grape root. It contains an alkaloid, berberine, which is also found in menispermum (a drug dropped from the present revision), calumba, hydrastis, and other drugs.

Dose.—Average dose: 30 grains (2 Gm.), U. S. P.

Official Preparation.

Fluidextrăctum Berberīdis—Fluidextrăcti Berberīdis—Fluidextract of Berberis.—*Dose.*—Average dose: 30 minims (2 Cc.), U. S. P.

Physiological Action.—Berberis contains an active alkaloid, *berberine*, an alkaloid widely distributed in the plant kingdom. Its relations to hydrastis have given it a slight reputation as a uterine stimulant, but it is hardly more than an unnecessary bitter. It has no particular physiological action and little practical therapeutic worth.

DRUGS ACTING PARTICULARLY ON THE KIDNEYS.

DIURETICS.

DIURETICS are drugs which increase the flow of urine. Considered in a broader sense, however, these agents augment the secretion and modify the character of the urine:

1. By increasing the amount.
2. By rendering the urine acid.
3. By rendering the urine alkaline.
4. By removing waste products or increasing the solid constituents of the urine.

By preventing the decomposition of the urine.

The last-named action is peculiar to benzoic * and salicylic * acids, cubeb, copaiba, uva ursi, oil of sandalwood, volatile oils, * saccharin, hexamethylenamina, and salol.[1]

The following medicines affecting the urinary system are called *Lithontriptics*, because of their supposed power to prevent the formation of concretions in the urinary passages or to dissolve them when formed:

Piperazin, potassium salts,* lithium salts,* ammonium benzoate,* benzoic acid,* dilute nitric acid.*

Among the principal drugs which render the urine *acid* are—benzoic * and salicylic acids,* and many of their salts, immoderate amounts of the vegetable acids,* and sour wines.*

The alkalies,* particularly the potassium and lithium salts, when taken internally, render the urine *alkaline* in reaction.

Diuretics may be either direct or indirect—*i. e.*, they may act on the kidneys themselves or upon certain structures outside the kidneys. The structures in the kidneys which have to do with the elimination of water, solids, etc., are: 1. The *Malpighian tufts*, which eliminate principally water, but also mineral salts and certain pathological and foreign substances which may be present. 2. *The glandular epithelium lining the convoluted tubules*, which excretes waste-products, such as urea, etc. 3. The *constricted portion of the tubules*, serving to prevent (according to the Cohnheim-Bauman theory) the too-rapid escape of water, thus allowing time for its absorption in cases where it is desirable that the water be retained in the system.

The functional activity of these various structures is regulated by the nervous mechanism through its influence upon the blood-supply. For example, the supply of blood to the glomeruli is influenced

[1] The drugs marked with an asterisk (*) are described elsewhere in the present work.

largely by the size of the blood-vessels, regulated by the vasoconstrictor and vasodilator nerves; but it has not been proved that the secretory cells are in any way affected by the nervous mechanism.

Diuretics act:

1. By increasing the general blood-pressure.
2. By causing local dilatation of the renal arterioles.
3. By directly stimulating the glandular secreting renal structures.
4. By simple mechanical force.

The following table, modified from Brunton's work on *Pharmacology, Therapeutics, and Materia Medica*, serves to elucidate the methods by which the various diuretic agents probably exert their influence:

Raise arterial pressure.	Generally . .	Increased cardiac action.	Digitalis,* Alcohol.*
		General vascular contraction.	Digitalis,* Strophanthus,* Squill, Scoparius,* Convallaria,* Strychnine,* Caffeine,* Erythrophleum (cold to the skin).
Locally on kidneys.	Contract efferent vessels.	Act on the vaso-motor centers.	Same as above?
		Locally on kidney.	Scoparius,* Buchu, Uva Ursi, Juniper, Turpentine, Copaiba, Cantharides.*
	Dilate efferent vessels.	Act either on vaso-motor centers or locally on renal vessels.	Nitrites,* Alcohol.*
Act on secreting nerves and renal cells.	Increase water excreted		Urea, Caffeine,* Diuretin, Calomel.*
	Increase water and solids excreted .		Colchicum,* Liquor Potassæ,* Potassium Acetate,* Potassium Citrate,* Potassium Nitrate,* Sodium Citrate * and other salines.
By simple mechanical action			Water, local bleeding, dry cupping, warm fomentations.

The secretion of urine is considerably influenced by the activity of the skin and bowels; for instance, when the cutaneous glands are stimulated and there is free perspiration, a diminished urinary secretion ensues. The functional activity of the skin and sudoriparous glands depends greatly upon the amount of blood supplied to them. Whatever augments the flow of blood to these structures increases the secretion of the sweat-glands. Consequently, external warmth dilates the cutaneous blood-vessels and promotes diaphoresis, while cold contracts the cutaneous vessels, diverting the flow of blood to the internal organs, thereby increasing the secretion from the kidneys and lessening that from the skin.

It will be seen, therefore, that the functions of the skin and kidneys are compensatory, the compensation being also partially observable in the mutual relations between the bowels and kidneys. It is well known that when there is active purgation, with frequent watery movements from the bowels, the amount of urine secreted is proportionally diminished.

Any drug which increases the general blood-pressure and forces a larger blood-supply into the kidneys augments the pressure in the glomeruli, distending the capsule and enlarging the area of the osmotic membrane, which action, combined with an increase in the circulation, promotes and facilitates filtration, thereby augmenting the amount of urine.

The blood-pressure in the glomeruli, as has been said, may be increased by additional pressure in the general circulation. It may be raised also locally through dilatation of the *afferent* blood-vessels supplying the Malpighian corpuscle, or contraction of the *efferent* vessels, allowing a smaller quantity of blood to escape from the glomerules.

The secreting structures of the convoluted tubules are stimulated by the influence of certain drugs which are carried in the blood, acting as excitants upon the secreting cells. This necessarily requires an extra supply of blood to the part furnishing material for the extra secretion.

The imbibition of large amounts of water, while increasing the blood-pressure to some extent, mechanically increases the amount of water eliminated by the kidney. This is commonly known as the "flushing action," and renders the urine more dilute.

In congested conditions of the kidneys certain remedial measures—such as local venesection, dry cupping, warm fomentations, etc.—promote renal secretion.

Therapeutics.—1. *To remove excessive accumulation of fluid in the tissues and serous cavities of the body when the blood-pressure is low.*

For this purpose the most efficient service is derived from the use of drugs which act by increasing the systemic blood-pressure, and stimulating the secreting cells of the kidneys.

Ordinarily, the agents most beneficial in *cardiac dropsy* or drop-

sies due to venous congestion are digitalis, calomel, scoparius, squill, diuretin, etc.

2. *To remove excess of fluid from the body when the blood-pressure is about normal,* as in cases of *hepatic cirrhosis* with *dropsy.*

The remedies found to be most efficient in these conditions are diuretin, copaiba, and calomel, although frequently saline purgatives, by ridding the peritoneal cavity of excess of water and preventing the accumulation of fluid by lowering the abnormally high blood-pressure in the portal circulation, prove more beneficial than diuretics.

3. *To remove water fròm the blood when the arterial pressure is abnormally high.*

For this purpose diuretics are indicated in the early stages of many acute diseases, such as the *eruptive fevers, tonsillitis, bronchitis,* etc. In these cases agents which dilate the cutaneous blood-vessels, such as spirit of nitrous ether, etc., should be employed. Diaphoretics and cathartics are likewise beneficial.

4. *To remove injurious waste products and poisonous substances from the blood.*

For this purpose drugs which stimulate the convoluted tubules and increase oxidation should be given, such as potassium nitrate and bitartrate, the lithium salts, turpentine, juniper, diuretin, and the remedies mentioned under *Lithontriptics.*

The foregoing remedies will be found useful in diseases associated with *rheumatic, gouty,* and *uric-acid diathesis,* as well as in many acute diseases where there is rapid accumulation of deleterious, catabolic material.

5. *To lessen the acidity of the urine.*

The alkalies and the alkaline salts of the organic acids are the most useful agents for this purpose, being serviceable in such conditions as *gonorrhea* and acute inflammatory states of the genito-urinary tract. In debilitated conditions there is quite often an excessive acidity of the urine, irritating the mucous membrane and causing frequent micturition. In such cases the alkaline diuretics or alkaline mineral waters are of service.

6. *To increase the acidity of the urine.*

This is necessary when, from any cause, there is ammoniacal decomposition of the urine, as in *cystitis.* In such cases benzoic acid is probably the most beneficial remedy, though the salicylates, salol, and the volatile oils, etc., may also prove useful.

7. *To prevent the formation of urinary concretions or to dissolve them when formed,* as in cases of *renal calculi,* etc.

For these purposes the drugs included under *Lithontriptics* are the most efficient.

8. *To dilute the urine.*

This process is necessary to prevent the deposit of urinary solids from forming *calculi* in the kidneys or bladder. For this purpose water or the alkaline mineral waters, taken in large quantities, will prove most useful.

Administration.—Diuretics are often very uncertain in their action, in health many of them apparently exerting no influence upon the kidneys, and in diseased conditions not infrequently proving inert. They are more certain in their action when employed in combination—that is, a union of drugs which act both generally upon the systemic circulation and locally upon the various secreting structures of the kidneys. Diaphoretics, being diverse in their action, should not be given with diuretics.

When administered, diuretics should be freely diluted with water. The patient's skin should be kept cool and the bowels prevented from acting too freely, in order that the full benefit of this class of remedies may be obtained.

The diuretic drugs not described elsewhere in the present work are herewith considered in detail.

Diurētin—Diurētin—Diuretin. (*Non-official.*)

(SODIOSALICYLATE OF THEOBROMINE.)

Origin.—The name indicates the origin, the drug being a chemical combination of theobromine (49.7 per cent.) and salicylic acid (38.1 per cent.). It is, in reality, a mixture of theobromine and sodium salicylate.

Description and Properties.—A white powder, soluble in less than half its weight of hot water, the solution remaining perfect on cooling. Sparingly soluble in cold water; soluble in warm alcohol; insoluble in chloroform or ether. The drug has a disagreeable, soap-like taste, and undergoes decomposition when exposed to the air.

Dose.—15 grains (1.0 Gm.); 45 to 105 grains (2.9–7.0 Gm.) may be given in divided portions in twenty-four hours.

Antagonists and Incompatibles.—The action of the drug would be retarded by the motor and cardiac depressants. Mineral and vegetable acids are incompatible.

Synergists.—The therapeutic influence of the drug would theoretically be enhanced by caffeine, digitalis, and many of the cardiac stimulants and diuretics.

Physiological Action.—*Externally and Locally.*—There is none. Theobromine, being a xanthin derivative, has the action of that series of compounds. See *Caffeine.*

Internally.—*Digestive System.*—Diuretin has no important action, though in many cases it may cause disturbance of digestion, impair the appetite, and even occasion nausea, vomiting, and diarrhea.

Circulatory System.—The drug has a very beneficial action upon the system in failing compensation and edema, its favorable influence being due to its effect upon the kidneys. Theobromine, like caffeine, exercises a direct, stimulating action upon the renal epithelium and also a very slight stimulating effect upon the vasomotor center in the medulla.

Nervous System.—Large and continued doses frequently occasion headache, somnolence, or insomnia, with buzzing in the ears, and symptoms resembling those produced by the salicylates. The

xanthin action is to stimulate the vasomotor centers, and slight stimulation of the respiratory center. Theobromine is one of the least stimulating xanthins and shows little of this action.

Repiratory System.—Diuretin exerts no direct influence upon the respiratory system. Yet dyspnea, bronchitis, etc., the result of a dropsical condition, are relieved by the administration of the drug.

Absorption and Elimination.—Diuretin is somewhat rapidly absorbed, being eliminated mainly by the kidneys, the process greatly stimulating the renal epithelium. The rise in blood-pressure is helpful, but the chief action has been shown to be on the renal epithelium. Both fluid and solid parts are increased. The chief increase in solids taking place in the chlorides. The amount of nitrogenous matter eliminated is also increased.

In cases where diuretin is indicated the amount of urine is increased from three- to sixfold in twenty-four hours, under its administration the diuretic action of the drug gradually reaching its maximum between the second and third days. In the case of healthy persons diuretin has little influence upon the amount of urine excreted.

Untoward Action.—In certain individuals the drug causes great disturbance of the gastro-intestinal tract, such as nausea, vomiting, diarrhea, palpitation of the heart, headache, and slight fever; occasionally cutaneous eruptions may be present.

Poisoning.—No cases of poisoning are recorded.

Therapeutics.—The drug is used exclusively as a diuretic in cases of *dropsy*, *ascites*, *pleuritic effusion*, etc.

Diuretin is worthy of a thorough trial for the removal of *dropsical fluids*, irrespective of the cause.

Diuretin is best suited to cases in which there is *general dropsical effusion*. It is the best medicinal remedy for removing dropsical fluid due to *valvular disease of the heart* after digitalis and pure cardiac tonics have failed. Diuretin has oftentimes a beneficial effect in other circulatory diseases with dropsy, as *myocarditis*, *pericarditis*, *aneurism*, *arteriosclerosis*. Its action is here more uncertain than in valvular disease. In the *dropsy of nephritis* it can be used without danger of irritating the kidney, the effects in *acute nephritis* being more certain than in chronic nephritis. Where the renal epithelium has undergone too extensive degeneration the drug may fail to act. In the *dropsy of portal obstruction*, and especially of *cirrhosis of the liver*, it usually fails to give good results.

Contraindications.—There are no special contraindications to the use of diuretin, unless it be in cases of marked gastric irritation, when the drug would undoubtedly aggravate the symptoms.

Administration.—Diuretin may be given in capsules or dissolved in some aromatic water or in milk. It should never be dispensed in powders, since it absorbs carbonic acid from the air and undergoes decomposition.

It is preferable to give the drug in solution; and it can be easily associated with digitalis and similar remedies, but when used with the cardiac remedies the doses of diuretin should be smaller.

When giving this drug in cases of marked ascites, or for the removal of large quantities of dropsical fluid, the first doses should be small and gradually increased to the maximum amount or until the desired effect be produced, lest by a too sudden removal of the fluid alarming collapse ensue.

As acids are incompatible with the drug, diuretin should not be given immediately after meals, but its administration postponed for about three hours to avoid unpleasant symptoms arising from the action of the gastric juice upon the remedy.

The practice of adding fruit syrups or juices to a solution of diuretin for the purpose of rendering it more palatable should be strictly avoided, since the theobromine is precipitated by the vegetable acids as a thick white sediment.

The maximum daily amount which can be safely administered is 150 grains (9.72 Gm.). The average daily amount is 45 to 105 grains (2.9–7.0 Gm.), given in divided doses of about 15 grains (1.0 Gm.) each.

If diuresis is not increased in six days, the use of the drug should be suspended and recourse to other treatment adopted.

Piperazīnum—Piperazīni—Piperazin. (*Non-official.*)

(Piperazidine; Ethyleneimine; Diethylenediamine; Dispermine.)

Origin.—Obtained by the action of ammonia on bromide or chloride of ethylene, $NH\left\langle\begin{matrix}CH_2-CH_2\\CH_2-CH_2\end{matrix}\right\rangle NH$.

Description and Properties.—It occurs as a crystalline solid, exceedingly soluble in water, the solution being practically tasteless. When exposed to the air the drug is very deliquescent, becoming completely liquefied on long exposure.

Dose.—5–15 grains (0.3–1.0 Gm.).

Piperazin, Lycetol, Lysidine, and Urotropine are closely related compounds, all introduced to dissolve uric acid in the body. Since a partial death blow has recently been administered to the "uric-acid phobia," the therapeutic facilities in this line are less sought after. What is here written of piperazin is probably true of this entire series of bodies.

Antagonists and Incompatibles.—The incompatibles are alkaloids, tannic acid, preparations of cinchona, salts of iron, alum, Donovan's solution, acetanilid, phenacetine, and sodium salicylate.

Synergists.—Lithium and its salts and the lithontriptics.

Physiological Action and Therapeutics.—The drug apparently has no effect whatever upon either the digestive, circulatory, or respiratory systems. Excessive doses, however, have affected the nervous system, producing certain untoward manifestations, such as muscular tremors, hallucinations, and clonic spasms.

The drug is non-irritating when applied to mucous membranes.

Piperazin is rapidly absorbed from the stomach, circulates in the blood unchanged, and is eliminated in the urine.

The only important action of piperazin is its property of dissolving uric acid, with which it forms a neutral and exceedingly soluble salt, piperazin urate, said to be seven times more soluble in water than lithium urate. This action is prominent in test-tubes, but it is highly doubtful if it is as serviceable in the human body.

Therapeutics.—*Externally and Locally.*—A solution of piperazin (1 to 2 per cent.) in a mixture of water and alcohol (1 to 4, respectively) has been applied locally to *gouty joints* and *swellings* with doubtful results.

Solutions of piperazin may be injected into the bladder in order to dissolve *vesical calculi.* They seem to have a slight action.

In the treatment of gout some observers have reported good results. For renal and vesical calculi of the urates it is doubtful if this drug is of much service, yet it is worthy of extended trial. It is of service in *chronic cystitis* and in some forms of *arthritis.* The *pruritus of diabetes* is often benefited by it.

The good results which have been reported from the use of these uric-acid solvents is largely to be attributed to the immense quantities of water with which their administration is combined.

Contraindications.—None of importance can be named.

Administration.—Piperazin is best given in aërated water, although it may be acceptably administered in distilled water and syrup, orange flower water, or other agreeable vehicle.

Hexamethylenamīna—Hexamethylenamīnæ—Hexamethylenamine. *U. S. P.*

Definition.—A condensation product of formaldehyde and ammonia, $(CH_2)_6N_4$. Chemically it is hexamethylene-tetramine. Also known as *aminoform*, *ammonioformaldehyde*, *cystamine*, *cystogen*, *formin*, *uritone*, and *urotropin.*

Description and Properties.—Colorless, lustrous, odorless crystals, having a sweetish, then somewhat bitter, taste. Its aqueous solution has an alkaline reaction to litmus-paper. Easily soluble in water (1 : 1.5), less so in alcohol (1 : 10). In solution it is decomposed by dilute sulphuric acid with liberation of formaldehyde; it is precipitated by tannic acid and mercuric chloride.

Dose.—Average dose: 4 grains (0.250 Gm.) = 250 milligrammes, U. S. P.

Allied Compounds.

Hexamethylene-tetramine readily forms compounds with a large number of substances; among those suggested for use in medicine the following may be mentioned:

Hexamethylenamine salicylate, urotropin salicylate, or **saliformin**; a colorless, crystalline powder of nauseous, sweetish, astringent taste.

Hexamethylenamine-ethylbromide, bromalin, or **bromoformin**; a colorless, crystalline powder of a sweetish, saline taste.

Hexamethylenamine-tannin, tannopin, or **tannon**; a brown, tasteless powder, nearly insoluble in water and alcohol.

Dioxybenzol-hexamethylenamine, hetralin, contains 60 per cent. of hexamethylenamine.

Chinotropin and **chinoformin** are quinates of *hexamethylenamine.* **Helmitol** is a recently introduced compound of hexamethylenamine with anhydromethylene citric acid. **Citarin** (sodium anhydromethylene citrate) is another compound from which formaldehyde is split off in the organism.

Therapeutics.—The chief action of hexamethylenamina is to act as a germicide in the urine. It is eliminated in the urine and broken down as formaldehyde. It is particularly valuable in cystitis, in gonorrhea, in typhoid fever, and in all conditions in which it is desired to avoid urinary infection or to lessen its severity.

Scĭlla—Scĭllæ—Squill. *U. S. P.*

Origin.—The bulb of *Urginea maritima* (L.) Baker, a plant indigenous in the basin of the Mediterranean, from Syria westward to the coast of the Atlantic. The bulb is deprived of its dry, membranaceous outer scales and cut into thin slices, the central portions being rejected.

Description and Properties.—Occurring in narrow segments about 2 inches (5 Cm.) long, slightly translucent, yellowish-white or reddish, brittle and pulverizable when dry, tough and flexible after exposure to damp air; inodorous; taste mucilaginous, bitter, and acrid. Merck isolated three active glycosides—*scillipicrin*, *scillitoxin* (both acting upon the heart), and *scillin* (an emetic principle)—together with various unimportant substances, such as mucilage, sugar, etc. Jamerstedt's scillain has been held to be identical with Merck's scillitoxin.

Dose.—1–4 grains (0.06–0.25 Gm.) [2 grains (0.125 Gm.), U. S. P.].

Official Preparations.

Acētum Scĭllæ—Acēti Scĭllæ—Vinegar of Squill (10 per cent.).—*Dose*, 10–30 minims (0.6–2.0 Cc.) [15 minims (1 Cc.), U. S. P.].

Fluidextrăctum Scĭllæ—Fluidextrăcti Scĭllæ—Fluidextract of Squill.—*Dose*, 1–4 minims (0.065–0.25 Cc.) [1½ minims (0.1 Cc.), U. S. P.].

Sy̆rupus Scĭllæ—Sy̆rupi Scĭllæ—Syrup of Squill (45 per cent. of the Acetum).—*Dose*, 30–60 minims (2.0–4.0 Cc.) [30 minims (2 Cc.), U. S. P.].

Sy̆rupus Scĭllæ Compŏsitus—Sy̆rupi Scĭllæ Compŏsiti—Compound Syrup of Squill.—Fluidextract 8 per cent., with fluidextract of senega 8 per cent., and tartar emetic 0.2 per cent., or ⅛ grain (0.008 Gm.) to 1 fluidram (4.0 Cc.).—*Dose*, 15 minims to 2 fluidrams (1.0–8.0 Cc.) [30 minims (2 Cc.), U. S. P.].

Tinctūra Scĭllæ—Tinctūræ Scĭllæ—Tincture of Squill (10 per cent.).—*Dose*, 5–20 minims (0.3–1.3 Cc.) [15 minims (1 Cc.), U. S. P.].

Antagonists and Incompatibles.—The action of squill upon the circulatory system is antagonized by the cardiac depressants. Tannic acid is incompatible.

Synergists.—The diuretic action of squill is enhanced by the diuretics and many of the cardiac stimulants. As an expectorant the drug is aided by senega and tartar emetic.

Physiological Action.—*Externally and Locally.*—There is no action of special importance. Applied to mucous membranes, however, squill acts as an irritant.

Internally.—*Digestive System.*—Large doses of the drug excite nausea, vomiting, and purging. Excessive amounts may produce gastro-enteritis.

Circulatory System.—The action of squill upon the heart and blood-vessels resembles that of digitalis, although as a cardiac stimulant digitalis is the more powerful.

Nervous System.—Squills has little action on the nervous system in medicinal doses.

Respiratory System.—The bronchial mucus is increased and expectoration facilitated by small doses of squill. Toxic doses render the respiration rapid and shallow.

Absorption and Elimination.—The active principles of squill are quickly diffused through the blood, being eliminated chiefly by the kidneys and bronchial mucous membrane.

In the passage of squill through the kidneys the renal epithelium is stimulated by the drug, which influence, together with the drug's action upon the systemic circulation, renders squill an active and valuable diuretic, increasing not only the amount of urine, but also the quantity of inorganic solids.

Very large doses irritate and inflame the kidneys, resulting in strangury and hematuria, with occasionally entire suppression of urinary flow.

Untoward Action.—This does not differ essentially from the symptoms of "Poisoning."

Poisoning.—In toxic doses squill acts as an acrid narcotic poison. The symptoms produced by excessive doses are—nausea, violent vomiting, serous and bloody diarrhea, severe griping, a sensation of burning in the throat, vesical tenesmus accompanied by pain, bloody urine, and, perhaps, entire suppression of the urinary flow. The pulse is feeble and slow or sometimes rapid, the symptoms terminating in collapse and death, occasionally preceded by convulsions. The death of a child three to five years of age has occurred from the taking of a half-teaspoonful of the syrup of squill.

Treatment of Poisoning.—The stomach should be evacuated and demulcent drinks freely given. Opium may be necessary to relieve pain, while diffusible stimulants serve to counteract cardiac and respiratory depression. Otherwise as in digitalis poisoning.

Therapeutics.—SQUILL is not used externally and locally. It has been employed internally as a diuretic in *dropsy*. When associated with digitalis and calomel it is an exceedingly active diuretic in cases of *cardiac dropsy*, *chronic pleurisy*, and *pericarditis with effusion*.

Squill is an efficient expectorant, the VINEGAR, SYRUP, and COMPOUND SYRUP OF SQUILL being useful preparations in *subacute* and *chronic forms of bronchitis*, particularly when the sputum is tenacious and expelled with difficulty.

Contraindications.—Squill should not be employed in cases of acute diseases of the kidneys. It is also inadmissible in acute bronchitis and in phthisis.

Administration.—Any of the preparations of the drug may be given, to be prescribed well diluted with syrup or glycerin.

Inasmuch as the diuretic action of squill ceases after a while, the doses should be repeated and gradually enlarged until some untoward action intervenes, when further increase should be suspended.

Because of its too-irritating properties the drug is seldom given alone when desired for its diuretic action.

Owing to the free acetic acid which it contains, syrup of squill is incompatible with ammonium carbonate and other alkalies.

Erythrophlēum—Erythrophlēi—Erythrophleum.
(*Non-official.*)

(CASCA BARK.)

Origin.—A glycosid obtained from the bark of *Erythrophlœum Guineense* Don, known under the names of *Casca bark*, *Sassy bark*, and *Ordeal bark*. The tree is a native of West Africa, the plant being used by the natives as an *ordeal* in witchcraft.

Description and Properties.—Erythrophlein hydrochloride, the salt usually employed, occurs in the form of whitish crystals, soluble in water.

Dose.—$\frac{1}{60}$–$\frac{1}{12}$ grain (0.01–0.005 Gm.).

Physiological Action and Therapeutics.—The powdered bark when inhaled causes violent sneezing. The tincture of the bark, or the glycosid, when taken in poisonous doses occasions nausea, vomiting, purging, intense headache, intoxication, convulsions, and death.

In medicinal doses the drug affects the circulatory system after the manner of digitalis, and acts upon the kidneys as an active diuretic. It was at one time supposed to be a powerful local anesthetic; further examination, however, has proved the claim to be unfounded.

Casca bark or its glycosid has been employed in *intermittent fever*, *diarrhea*, *dysentery*, and *dyspepsia*. Its chief medical uses are in valvular disease of the heart and as a diuretic in *cardiac* and *renal dropsies*.

Administration.—A tincture of the bark (10 per cent. strength) may be given internally, diluted with water, in doses of 5 to 10 minims (0.3–0.6 Cc.). Erythrophlein hydrochlorate is usually given hypodermically.

Būchu—Būchu—Buchu. *U. S. P.*

Origin.—The dried leaves of *Barosma betulina* (Thunberg) Bartling et Wendland, a shrub attaining a height of several feet, indigenous in the southern portion of Africa, particularly in various parts of Cape Colony.

Description and Properties.—The leaves are ½ to ¾ inch (12 to 19 Mm.) long, roundish-obovate, with rather wedge-shaped base, or varying between oval and obovate, crenate or serrate, with a gland at the base of each tooth, dull yellowish-green, thickish, pellucid-punctate; odor and taste strongly aromatic, somewhat mint-like, pungent, and bitterish. Buchu contains from 1 to 2 per cent. of a *volatile oil*, which, on exposure to a low temperature, releases *barosma camphor* or diosphenol, $C_{10}H_{16}O_2$. The bitter principle of buchu is *rutin*; resin is also present.

Dose.—15–30 grains (1.0–2.0 Gm.) [30 grains (2 Gm.), U. S. P.].

Official Preparation.

Fluidextrăctum Būchu—Fluidextrăcti Būchu—Fluidextract of Buchu.—*Dose*, 15–30 minims (1.0–2.0 Cc.) [30 minims (2 Cc.), U. S. P.].

Physiological Action and Therapeutics.—Externally and locally buchu has no action of importance. When ingested it acts as a carminative, in small doses occasioning a feeling of warmth, but in excessive doses acting as an irritant.

Upon the circulation the influence of the drug is that of a mild stimulant.

Its active constituents are rapidly diffused through the blood, and are eliminated principally by the kidneys, the bronchial mucous membrane sharing in the excretory process.

Buchu increases the fluid and solid constituents of the urine, imparting to it a peculiar aromatic odor. The drug acts as a tonic astringent and disinfectant to the mucous membranes, from which it is eliminated, diminishing the secretions.

If taken for too long a period, irritation and inflammation of the kidneys are apt to ensue because of excessive stimulation.

The drug is chiefly employed as a stimulant diuretic and expectorant in catarrhal conditions of the genito-urinary organs and bronchial tubes. Buchu is therefore of service in *urethritis*, *gonorrhea*, *gleet*, *chronic cystitis*, *incontinence of urine* due to want of muscular tone, *pyelitis*, etc. The drug has also proved beneficial in certain cases of *chronic bronchitis*, and has even been recommended in *chronic rheumatism* and *lithemia*.

Contraindications.—Buchu is contraindicated in acute inflammation of the kidneys.

Administration.—The fluidextract and the infusion are the only preparations employed. They should be given freely diluted with water.

Ūva Ŭrsi—Ūvæ Ŭrsi—Uva Ursi. *U. S. P.*

(Bearberry.)

Origin.—The dried leaves of *Arctostaphylos Uva Ursi* (L.) Sprengel, a trailing evergreen plant distributed throughout the northern portion of North America, extending as far south as New Jersey and westward to Colorado. The plant is also found in most parts of Europe and in Northern Asia.

Description and Properties.—Leaves very short-stalked, obovate or oblong-spatulate, coriaceous, about ⅘ inch (2 Cm.) long and ¼ to ⅓ inch (6 to 8 Mm.) wide, obtuse, with slightly revolute edges, upper surface with depressed veins, lower surface distinctly reticulate; odor faint, hay-like; taste strongly astringent and somewhat bitter.

Uva ursi contains three glycosides, *arbutin*, *methylarbutin*, and *ericolin*, and a tasteless principle, *urzone*, besides tannic and gallic acids.

Dose.—15–60 grains (1.0–4.0 Gm.) [30 grains (2 Gm.), U. S. P.).

Official Preparation.

Fluidextrăctum Ūvæ Ŭrsi—Fluidextrăcti Ūvæ Ŭrsi—Fluidextract of Uva Ursi.—*Dose*, 15–60 minims (1.0–4.0 Cc.) [30 minims (2 Cc.), U. S. P.].

The **physiological action** and **therapeutics** of uva ursi are analogous to those of buchu. The arbutin and methylarbutin are capable of being split into glucose and hydrochinon or methylhydrochinon, to which latter substances the antiseptic action of this drug is due. Hence uva ursi is particularly valuable as a urinary antiseptic. It is of service in cystitis especially and is a useful drug in prostatic hypertrophy to limit urinary infection.

Junĭperus—Junĭperi—Juniper. (*Non-official.*)

(JUNIPER BERRIES.)

Origin.—The fruit of *Juniperis communis* (L.), an evergreen tree indigenous in the northern hemisphere and found in the United States and Canada and in Europe.

Description and Properties.—Berries globular, about the size of a large pea, externally of a glossy, purplish-black color, covered with a grayish bloom. They have an aromatic, balsamic odor, and a sweet terebinthinate, bitterish, and slightly acrid taste. Juniper contains a volatile oil; also juniperin, sugar, wax, fat, etc.

Dose.—15–60 grains (1.0–4.0 Gm.).

Ōleum Junĭperi—Ōlei Junĭperi—Oil of Juniper. *U. S. P.*

Origin.—A volatile oil distilled from the fruit of *Juniperus communis.*

Description and Properties.—A colorless or faintly greenish-yellow liquid, becoming darker and thicker through age and exposure to air, having the characteristic odor of juniper and a warm, aromatic, somewhat terebinthinate and bitterish taste. Soluble in about four times its volume of alcohol, forming a more or less turbid liquid, which is neutral or slightly acid to litmus-paper.

Dose.—5–15 minims (0.3–1.0 Cc.) [30 minims (0.2 Cc.), U. S. P.].

Official Preparations.

Spĭritus Junĭperi—Spĭritus Junĭperi—Spirit of Juniper.—*Dose*, 1–8 fluidrams (4.0–30.0 Cc.). Formula: Oil of juniper, 5; alcohol, 95 parts [30 minims (2 Cc.), U. S. P.].

Spĭritus Junĭperi Compŏsitus—Spĭritus Junĭperi Compŏsiti—Compound Spirit of Juniper.—Formula: Oil of juniper, 8; oil of caraway, 1; oil of fennel, 1; alcohol, 1700; water, sufficient to make 2000 parts.—*Dose*, 2–4 fluidrams (8.0–15.0 Cc.) [2 fluidrams (8 Cc.), U. S. P.].

Physiological Action and Therapeutics.—Juniper in its action resembles buchu, being a stimulant diuretic. Under certain conditions it acts as a diaphoretic. It is a tonic to the stomach and a mild aphrodisiac.

The volatile oil, which is the active constituent of juniper, diffuses through the blood with great facility, stimulating the heart, and, in dropsical conditions, increasing the flow of urine. In health, however, the amount of urine is diminished, while that of urea is augmented.

Juniper is used for the same purposes as buchu—being superior to the latter drug perhaps—especially in various *dropsies* and *passive congestion of the kidneys.*

Contraindications.—The same as for buchu.

Administration.—Any of the preparations may be given, gin being a popular diuretic.

Copaība—Copaībæ—Copaiba. *U. S. P.*

(BALSAM OF COPAIBA.)

Definition.—An oleoresin derived from one or more South American species of Copaiba.

Description and Properties.—A transparent or translucent, more or less viscid liquid of a pale-yellow to brownish-yellow color, having a peculiar aromatic odor

and a bitter, acrid taste. Insoluble in water; readily soluble in absolute alcohol, ether, chloroform, carbon disulphide, benzin, and fixed and volatile oils.

Copaiba contains a *volatile oil, two resins, copaibic acid* (soluble in absolute alcohol and in ammonia), and a bitter principle.

Dose.—5–30 minims (0.3–2.0 Cc.) [15 minims (1 Cc.), U. S. P.] in emulsion or capsule.

Ōleum Copaībæ—Ōlei Copaībæ—Oil of Copaiba. *U. S. P.*

Origin.—A volatile oil distilled from copaiba.

Description and Properties.—A colorless or pale-yellowish liquid, having the characteristic odor of copaiba and an aromatic, bitterish, and a pungent taste. Soluble in about ten times its volume of alcohol, forming a slightly turbid liquid, which is neutral to litmus-paper. The drug should be kept in well-stoppered bottles, in a cool place. Caryophyllene is an important constituent of the oil.

Dose.—5–15 minims (0.3–1.0 Cc.) [8 minims (5 Cc.), U. S. P.].

Antagonists and Incompatibles.—Copaiba is antagonized by the same drugs which antagonize turpentine. It is pharmaceutically incompatible with aqueous preparations.

Synergists.—The same as for turpentine.

Physiological Action.—*Externally and Locally.*—Copaiba has no influence of importance, being but slightly stimulant to the skin.

Internally.—Digestive System.—Its action is analogous to that of turpentine and the volatile oils. The ingestion of the drug, even in small doses, is almost always succeeded by eructations tasting of copaiba.

Copaiba exerts no special influence upon the circulatory, nervous, and respiratory systems.

Absorption and Elimination.—The drug enters the circulation with facility, and is slowly eliminated by the skin and mucous membranes generally, although chiefly by the kidneys. The resin which the drug contains is a powerful stimulant of the genito-urinary structures, increasing the quantity, and to some extent the solid constituents, of the urine. Large doses irritate the kidneys, occasionally producing strangury, bloody urine, pain in the bladder, etc.

Under the use of copaiba albumin is sometimes found in the urine. Frequently the nitric-acid test with urine may give a reaction as if for albumin, the conclusions being then erroneous, since the resin of copaiba eliminated in the urine is by the action of nitric acid precipitated as a milky cloud, readily differentiated from albumin by heating the urine or mixing it with alcohol, by both of which means the resinous precipitate is dissolved.

Copaiba acts as a stimulant and disinfectant at the points of elimination, in medicinal amounts increasing secretion and imparting to the secretion from the kidneys, bronchial mucous membrane, and skin a peculiar, fragrant odor.

Untoward Action.—It often happens that after a few days' administration of copaiba there is produced in certain individuals an eruption, usually resembling roseola, which later may be trans-

formed into true papules; or the eruption may be scarlatiniform in character, or a true eczema ensue. These eruptions are first noticeable on the upper and lower extremities, backs of the hands and knees, malleoli, etc., and are attended with intense itching.

Under the prolonged use of the drug there may occur serious disturbances of the digestive and genito-urinary tracts.

Poisoning.—In addition to the untoward manifestations already mentioned, very large doses of copaiba produce symptoms similar to those described under Turpentine. Cases have been recorded in which excessive amounts occasioned paralysis and tetanoid attacks.

Treatment of Poisoning.—This should be the same as prescribed under Turpentine.

Therapeutics.—*Externally and Locally.*—Copaiba is of value in chronic diseases of the skin, such as *psoriasis*, *lupus*, etc. The drug has proved valuable in frost-bites.

Internally.—The principal use of COPAIBA is as a stimulant and disinfectant of the genito-urinary tract in cases of *gleet*, *subacute gonorrhea*, *vaginitis*, *cystitis*, *pyelitis*, etc.

In *ascites* and *dropsical conditions*, particularly those due to hepatic and cardiac diseases, the RESIN OF COPAIBA proves a very efficient and reliable diuretic. Under prolonged use, however, a tolerance appears to be established.

COPAIBA is a valuable remedy in *chronic bronchitis* and *bronchorrhea* with offensive expectoration.

The drug has been at times given internally with good results in *psoriasis*, *urticaria*, etc., although the internal use of copaiba in these disorders is less common than formerly.

The drug has found enthusiastic advocates as a remedy in *chronic diarrhea* and *dysentery*, and has also been recommended in *chronic proctitis* and *chronic intestinal catarrh*.

Contraindications.—The same as for turpentine.

Administration.—The methods of administration recommended for turpentine are applicable to this drug. It is claimed that many of the untoward manifestations produced by copaiba may be prevented by giving the drug with an alkali. With this object in view, in the Pharmacopœia of 1890 copaiba was associated with magnesia in the "Massa Copaibæ." Yet, while this preparation is perhaps less likely to produce untoward results, it is undoubtedly less active therapeutically than the single drug.

Sabāl—Sabāl—Sabal. *U. S. P.*

Definition.—The partially dried ripe fruit of *Serona serrulata*, commonly known as saw palmetto.

Very little is known concerning the active principles of saw palmetto. A volatile oil, a fixed oil, a fat, an alkaloid, a resin, and glucose have been isolated.

Dose.—Average dose: 15 grains (1 Gm.), U. S. P.

Physiological Action.—The oil of saw palmetto is thought to act in a manner similar to the oils of sandal, copaiba, etc.

Therapeutics.—It is useful in the chronic stages of gleet and in the cystitis of hypertrophied prostate.

Ōleum Săntali—Ōlei Săntali—Oil of Santal. *U. S. P.*

(OIL OF SANDALWOOD.)

Origin.—A volatile oil distilled from the wood of *Santalum album* L., yielding not less than 90 per cent. of alcohols calculated as santalol. *Santalum album* is a small tree indigenous in Southern India and portions of the East Indies.

Description and Properties.—A pale-yellowish or yellow, somewhat thickish liquid, having a peculiar, strongly aromatic odor and a pungent, spicy taste; readily soluble in alcohol. It is frequently adulterated with oil of cedar.

Dose.—5–20 minims (0.3–1.2 Cc.) [8 minims (0.5 Cc.), U. S. P.].

Physiological Action and Therapeutics.—The action of oil of sandalwood resembles closely that of copaiba, and it may be given for the same purposes as the latter drug, although oil of sandalwood is more popular, and ordinarily a more efficient, remedy for *gonorrhea*, particularly in the early stages. Sandalwood oil is one of the mildest of the genito-urinary stimulants. It is very frequently adulterated with a worthless oil of cedar.

Administration.—The same as in the case of copaiba.

Cubēba—Cubēbæ—Cubeb. *U. S. P.*

Origin.—The dried, unripe, but fully grown fruit of *Piper Cubeba* Linn. fil., a climbing diœcious shrub about 20 feet (6 M.) high, indigenous in Java.

Description and Properties.—Globular, about ⅙ or ⅕ inch (4 or 5 Mm.) in diameter, contracted at the base into a rounded stipe about ¼ or ⅜ inch (6 or 10 Mm.) long, reticulately wrinkled, blackish-gray, internally whitish and hollow; odor strong, spicy; taste aromatic and pungent. It contains from 5 to 15 per cent. of a *volatile oil*, an odorous principle, *cubebin*, and a diuretic principle, *cubebic acid*, besides resin, fat, wax, and starch.

Dose.—5–60 grains (0.32–4.0 Gm.) [15 grains (1 Gm.), U. S. P.].

Official Preparations.

Fluidextrăctum Cubēbæ—Fluidextrăcti Cubēbæ—Fluidextract of Cubeb.—*Dose*, 5–60 minims (0.2–4.0 Cc.) [15 minims (1 Cc.), U. S. P.].

Oleoresīna Cubēbæ—Oleoresīnæ Cubēbæ—Oleoresin of Cubeb.—*Dose*, 15–30 minims (0.32–2.0 Cc.) [7½ grains (0.5 Gm.), U. S. P.].

Trochĭsci Cubēbæ—Trochĭscos (acc.) Cubēbæ—Troches of Cubeb.—(Each troche contains ⅓ minim (0.02 Cc.) of the oleoresin.)—*Dose*, 1–6 troches.

Ōleum Cubēbæ—Ōlei Cubēbæ—Oil of Cubeb. *U. S. P.*

Origin.—A volatile oil distilled from cubeb.

Description and Properties.—A colorless, pale-greenish, or yellowish liquid, having the characteristic odor of cubeb and a warm, camphoraceous, aromatic taste. Soluble in an equal volume of alcohol. It should be kept in well-stoppered bottles, in a cool place, protected from light.

Dose.—5–15 minims (0.3–1.0 Cc.) [8 minims (0.5 Cc.), U. S. P.].

Synergists.—Buchu, copaiba, oil of santal, black pepper, and many of the aromatic and volatile oils.

Physiological Action.—*Externally and Locally.*—Like the aromatics and drugs containing a volatile oil, cubeb is irritant and rubefacient when applied by inunction.

Internally.—Digestive System.—In medicinal amounts cubeb is an aromatic stomachic, increasing the appetite and improving digestion. As is the case with other drugs of this class, large dosage or the too prolonged use of small amounts irritates the stomach and deranges digestion, cubeb acting as a laxative and occasioning a sensation of heat and discomfort about the rectum.

Internally it has the general action of the volatile oil series.

Absorption and Elimination.—Cubeb is absorbed and eliminated with considerable rapidity. It escapes from the body chiefly by the urine, though the skin and bronchial mucous membrane share in the excretory process. The drug acts as an active stimulant and disinfectant to the structures by which it is excreted, and is consequently a diuretic, expectorant, and mild diaphoretic.

The urine and the amount of uric acid are increased by cubeb, the drug appearing in the urine as a salt of cubebic acid, which may be precipitated by nitric acid, the precipitate resembling that of albumin.

Untoward Action.—Cubeb occasionally produces great disturbance in the gastro-intestinal tract, colicky pains, and diarrhea. The most frequent untoward manifestations, however, are various cutaneous eruptions, appearing in the form of papules, and oftentimes as a diffuse erythema. No febrile symptoms attend these eruptions, which usually disappear shortly after the suspension of the drug.

Poisoning.—Although cubeb is not regarded as a poison, very large doses may be followed by all the symptoms of severe gastro-intestinal irritation.

Treatment of Poisoning.—The indications are to empty the stomach, favor elimination, and treat the patient symptomatically by the use of demulcents, anodynes, stimulants, etc., as necessary.

Therapeutics.—*Externally and Locally.*—The drug is a deservedly popular remedy in many diseases of the *nose* and *throat.* The insufflation of an impalpable powder of cubeb or the inhalation of smoke from the burning drug is an efficient palliative to the sense of oppression arising from *turgescence of the nasal mucous membrane.*

The troches of cubeb are extensively used for *coughs, hoarseness,* etc. The oil of cubeb is used as an inhalant and as a local application in many diseases of the *throat* and *respiratory passages.*

Internally.—Cubeb is used internally for about the same purposes as copaiba, although by many physicians considered to be inferior to the latter drug in genito-urinary disorders.

Contraindications.—The same as for copaiba.

Administration.—Any of the preparations may be given. The oleoresin is best administered in capsules or emulsion.

Benzosulphinīdum—Benzosulphinīdi—Benzosulphinide. *U. S. P.*

(SACCHARIN.)

Definition.—An anhydride of orthosulphamide benzoic acid, $C_6H_4SO_2.CO.NH$. It is variously known as *glucosimide*, *saccharol*, *saccharinol*, *saccharinose*, *agucarine*, etc.

Description and Properties.—Its derivation from toluol (from which it is usually made) is shown by the following formulas:

$$C_6H_5CH_3 \longrightarrow C_6H_4 < \begin{matrix} SO_3H\,(1) \\ CH_3\,(2) \end{matrix} \longrightarrow C_6H_4 < \begin{matrix} SO_2NH_2 \\ CH_3 \end{matrix} \longrightarrow$$

Toluol. o-Toluolsulphonic-acid, o-Toluolsulphamide.

$$C_6H_4 < \begin{matrix} SO_2NH_2 \\ COOH \end{matrix} \longrightarrow C_6H_4 < \begin{matrix} SO_2 \\ CO \end{matrix} > NH$$

o-sulphamide-benzoic acid. Anhydride of o-sulphamide-benzoic acid (Saccharin).

Saccharin was discovered in 1879 by Ira Remsen and C. Fahlberg. It is a white, crystalline powder, nearly odorless, having an intensely sweet taste even in dilute solutions. The sweet taste may be recognized in a dilution of 1 : 100,000, as compared with cane-sugar, 1 : 200. Soluble in 250 parts of water and in 25 parts of alcohol; more so in boiling water (1 : 24). It behaves like a strong acid and dissolves readily in alkalies; the sodium salt ($C_6H_4 < \begin{matrix} CO \\ SO_2 \end{matrix} > NNa$) is known as *soluble saccharin* or *crystallose.*

The Liquor Saccharini of the National Formulary is a solution of saccharin in sodium bicarbonate and alcohol. There are a number of preparations on the market, such as *antidiabetin*, which contain saccharin (Hunt).

Dose.—Average dose: 3 grains (0.200 Gm. = 200 milligrammes. (U. S. P.)

Dulcin or *sucrol*, another very sweet substance, is para-phenetolcarbamid; *saxin* is a similar product.

Physiological Action.—In a neutral or alkaline medium, saccharin acts as an antiseptic. Internally it exerts no notable influence. It is said that when mixed with food it interferes with the action of saliva upon starch, and it is thought to retard the action of the other digestive ferments. The drug is not decomposed in the body, and is eliminated by the kidneys unchanged, increasing the amount of chlorides excreted in the urine, which fluid is so influenced by the drug that it does not so readily undergo fermentation.

Therapeutics.—*Externally and Locally.*—Saccharin is used as a mouth-wash, being especially beneficial in *aphthæ*. Felici, of Rome, highly recommends the application of a solution of saccharin in *ozena.*

Internally.—The principal use of the drug is as a substitute for sugar in cases of *diabetes*. It is sometimes useful as an antiseptic in cystitis. It also acts as benzoic acid in limiting intestinal putrefaction as well.

The drug is extensively used in various elixirs, syrups, etc., to overcome the bitterness of quinine and other bitter alkaloids.

Administration.—Saccharin should be given in solution, or in tablets which may be dissolved singly in a cup of coffee.

Peabody recommends the following formulæ:

℞.	Saccharin,	10.0;
	Sodium carbonate,	11.0;
	Aquæ,	q. s. 100.0.

Dose for tea, coffee, etc., to be determined by experiment.

℞.	Saccharin,	45 grains;
	Sodium carbonate,	30 grains;
	Mannite,	10 ounces.

Divide in 100 equal parts and use as lump sugar for sweetening purposes.

Methylthionīnæ Hydrochlōridum—Methylthionīnæ Hydrochlōridi—Methylthionine Hydrochloride. *U. S. P.*

(METHYLENE BLUE.)

Chemically, it is tetramethylthionine hydrochloride.

Properties.—Dark-green, crystalline powder, or prismatic crystals having a bronze-like luster. Readily soluble in water, somewhat less so in alcohol; the solutions are of a deep-blue color. Incompatible with potassium iodide. Reducing agents decolorize it. It is not to be confounded with commercial methylene blue, which is often the zinc chloride double salt of tetramethylthionine, is employed as a dye or stain, and is unfit for internal administration.

Dose.—Average dose: 4 grains 0.250 Gm. = 250 milligrammes, U. S. P.

Therapeutics.—It is an intercellular antiseptic, useful in destroying the malarial parasite. It is also of value in genito-urinary practice.

DIAPHORETICS.

DIAPHORETICS—or *sudorifics*, as they are also called—are medicines which promote diaphoresis or sweating. Their action in stimulating transpiration by the skin may be enhanced by exercise, external warmth, nauseants, and drugs which dilate the vessels, determining more blood to the cutaneous blood-vessels.

Diaphoretics are employed principally for their evacuant, revulsive, and alterative effects, and to promote absorption. Some of the drugs here considered might be classed with those whose chief action is on the spinal cord. Toxicologically they affect the cord—therapeutically they are used mainly as diaphoretics. This is particularly true of PILOCARPUS and PHYSOSTIGMA.

Pilocărpus—Pilocărpi—Pilocarpus. *U. S. P.*

(JABORANDI.)

Origin.—The leaflets of *Pilocarpus Jaborandi* Holmes or of *Pilocarpus microphyllus* Stapf., yielding not less than 0.5 per cent. of alkaloids.

Description and Properties.—Pilocarpus contains a *volatile oil* and two alkaloids, *pilocarpine* and *jaborine*, the latter being thought to be chemically isomeric with the former.

Pilocarpidine, in many ways the equivalent of pilocarpine, has recently been isolated.

Dose.—5–60 grains (0.3–4.0 Gm.).

Official Preparations.

Fluidextrăctum Pilocărpi—Fluidextrăcti Pilocărpi—Fluidextract of Pilocarpus.—*Dose*, 5–60 minims (0.3–4.0 Cc.).

Pilocarpīnæ Hydrochlōridum — Pilocarpīnæ Hydrochlōridi — Pilocarpine Hydrochloride.—*Origin.*—The hydrochloride of an alkaloid obtained from pilocarpus.

Description and Properties.—Small, white crystals, odorless, and of a faintly bitter taste; deliquescent on exposure to damp air. Very soluble in water and in alcohol. It should be kept in small, well-stoppered bottles.

Dose.—$\frac{1}{64}$–$\frac{1}{2}$ grain (0.001–0.03 Gm.).

Pilocarpīnæ Nītras—Pilocarpīnæ Nitrātis—Pilocarpine Nitrate.—*Definition.*—The nitrate ($C_{11}H_{16}N_2O_2.HNO_3$) of an alkaloid obtained from pilocarpus.

Character.—In colorless, or white, shining crystals, odorless, and having a faintly bitter taste. It is permanent in the air, whereas the hydrochloride is deliquescent on exposure to the air. Soluble in water (1 : 4), alcohol (1 : 60), warm alcohol (1 : 16).

Dose.—Average dose: $\frac{1}{6}$ grain (0.010 Gm. = 10 milligrammes, U. S. P.

Antagonists and Incompatibles.—Atropine is a physiological antagonist to pilocarpine, being directly opposite in its action throughout its entire range, $\frac{1}{100}$ grain (0.0006 Gm.) being sufficient to counteract $\frac{1}{6}$ grain (0.01 Gm.) of pilocarpine. Morphine relieves the nausea.

The incompatibles are tannic acid, caustic alkalies, and the ferric and metallic salts.

Synergists.—The cardiac depressants, particularly aconite and

veratrum viride, gelsemium, spirit of nitrous ether, and drugs which paralyze the vasomotor system.

Physiological Action.—*Externally and Locally.*—There is no action of importance.

Internally.—Digestive System.—The action of pilocarpine is here given, since the alkaloid fully represents the drug.

When pilocarpine is taken into the mouth, the ends of the chorda tympani and secretory nerves are stimulated, causing an increased secretion of saliva. Should large doses be taken, there is a feeling of tenderness in the mouth and severe salivation is produced. There is also a marked increase in the flow of tears.

The gastric glands are stimulated by the drug, their normal secretion being augmented. By stimulating the unstriped muscle-fibers pilocarpine increases peristalsis, both of the stomach and the intestines, in large doses acting as a cathartic. Immoderate amounts may also induce vomiting. The bile and pancreatic juice are not affected by moderate amounts of the drug.

Circulatory System.—At first the inhibitory fibers are stimulated, resulting in a slowed heart; but this soon gives over to rapid and palpitating heart action with raised blood-pressure.

Nervous System.—In medicinal amounts pilocarpine has no perceptible action on the central nervous system, although stimulating the nerve-terminations of involuntary muscles—*i. e.*, those of the stomach, intestines, heart, spleen, bladder, uterus, etc.

Poisonous doses have produced (in the frog) tetanic convulsions, followed by paralysis, the result of depression of the muscles and spinal centers, the nerves apparently being unaffected.

Respiratory System.—The respiratory movements are unaffected by medicinal amounts, but the bronchial secretion is augmented.

Absorption and Elimination.—Pilocarpine is rapidly absorbed, and is eliminated principally by the skin, occasioning free, and under large doses excessive, diaphoresis.

The sweat is at first acid, then neutral, and finally alkaline in reaction. The diaphoresis produced by pilocarpine is due to stimulation of the secretory nerves supplying the glands.

The kidneys, under small doses, are stimulated, there being a slight increase in the urine, and the amount of urea is considerably augmented. This may be a result of the stimulation to leucocytosis caused by this drug on the blood-forming organs.

The drug is also eliminated by the salivary glands, there being frequently an enormous increase in the salivary secretion. Under the influence of pilocarpine there is an increase in the gastric, bronchial, and lacrymal secretions, even the secretion of milk being notably augmented. Cushny states that pilocarpine is not a galactagogue.

Temperature.—Succeeding a very brief and slight elevation of temperature there is a decided diminution of bodily heat, resulting from the dilatation of cutaneous blood-vessels and the evaporation of the perspiration.

Eye.—Whether applied locally to the eye or taken internally, pilocarpine produces marked contraction of the pupil by stimulating the peripheral endings of the motor oculi nerves. The drug produces a primary increase of tension of the eyeball, followed by a more permanent diminution in tension.

Uterus.—There is authority for the statement that pilocarpine stimulates the gravid uterus, inducing uterine contractions or increasing the energy of those already established.

The effect of the drug upon the uterus, however, is more pronounced and apparent in cases of eclampsia, seeming to prove the fallacy of the statement that pilocarpine is a true ecbolic.

Untoward Action.—Nausea and vomiting are of quite frequent occurrence, the vomiting being preceded by long and distressing nausea. Occasionally the patient complains of severe pain in the urethra and in the lumbar region, with frequent desire to micturate.

There have often been present headache, vertigo, hiccough, dimness of vision, gastric and abdominal pains, stupor, and chilliness. Collapse may occur.

Poisoning.—The symptoms produced by poisonous doses of pilocarpine are exaggerations of those already described, together with diarrhea, exhausting and excessive sweating and salivation, marked cardiac and respiratory depression, and collapse.

Treatment of Poisoning.—If the drug has been ingested, the stomach should be immediately cleansed with a solution of tannic acid.

To counteract the untoward effects of pilocarpine, whether the drug has been ingested or given by subcutaneous injection, atropine is undoubtedly the most complete physiological antagonist, and should be given hypodermically. Morphine is indicated to control the nausea and vomiting, while some of the cardiac stimulants may be required to counteract cardiac depression.

Therapeutics.—*Externally and Locally.*—PILOCARPINE, or the FLUIDEXTRACT OF JABORANDI, has been highly recommended for *alopecia.* By the use of pilocarpine the hair becomes darker. The FLUIDEXTRACT OF PILOCARPUS has been employed as a local application in *erysipelas* and *eczema.*

Lozenges containing $\frac{1}{40}$ grain (0.001 Gm.) of PILOCARPINE are efficient in relieving *dryness of the throat.* As a myotic, pilocarpine is used in many *diseases of the eye.*

Internally.—The principal internal use of PILOCARPINE is as a diaphoretic in *Bright's disease.* It eliminates through the skin many products, particularly fluids, that otherwise must be eliminated by an overtaxed kidney. In cardiac dropsy it is not a safe remedy, because of its depressing influence upon the heart.

The drug is very efficient in removing *pleuritic effusion*, while in *uremic poisoning* it is unquestionably a valuable remedy.

The hypodermic injection of small doses of PILOCARPINE has been highly recommended as an efficient remedy in *erysipelas*, particularly during the first stages of the disease.

The drug has proved beneficial in *tobacco* and *alcoholic amblyopia.*

PILOCARPINE has been found useful in *humid asthma*, *bronchorrhea*, and *hiccough*, and, in *small doses*, in arresting the *sweating of phthisis* and for the relief of *ptyalism*. The drug is an efficient *galactogogue*, and has been used with success in *mumps*, *chronic enlargement of the cervical glands*, and *adenitis of the inguinal glands*.

PILOCARPINE materially lessens the flow of urine in *diabetes insipidus*, and in many *diseases* of the *eye* and *ear* the internal use of the drug serves a useful purpose.

The property possessed by PILOCARPINE of stimulating the glands of the skin renders this remedy of great service in many *chronic diseases of the skin* characterized by a dry, scaly condition. It is a peculiarly valuable agent in *phthiriasis*, *psoriasis*, certain forms of *eczema*, *pruritus senilis*, etc. PILOCARPINE or FLUIDEXTRACT OF JABORANDI may be useful in breaking up a *cold*.

Finally, PILOCARPINE has been highly recommended in *catarrhal jaundice*, and is one of the most efficient antidotes to *belladonna-poisoning*.

Contraindications.—The drug should never be employed when the heart is weak from thinning and atrophy of its walls or from fatty degeneration, nor where there is a tendency to pulmonary congestion and edema. The drug is also contraindicated in asthenic fevers, such as typhoid fever, etc.

Administration.—Pilocarpine is superior to the crude drug, being far more reliable in its action and less liable to produce nausea and vomiting. Pilocarpine is usually given hypodermically, although it is frequently administered by the mouth, in solution, or in troches.

Of all the preparations of the crude drug, the fluidextract and infusion are commonly employed, the latter being less apt to cause profuse salivation. An elixir of pilocarpus is prescribed considerably.

Should preparations of jaborandi be given upon an empty stomach, they are less apt to occasion nausea. This inconvenience may be also avoided by giving an infusion by the rectum.

Līquor Ammōnii Acetātis—Liquōris Ammōnii Acetātis—Solution of Ammonium Acetate. *U. S. P.*

(SPIRIT OF MINDERERUS.)

Origin.—An aqueous solution of ammonium acetate, containing about 7 per cent. of the salt, together with small amounts of acetic and carbonic acids.

Description and Properties.—A clear, colorless liquid free from empyreuma, of a mildly saline, acidulous taste and an acid reaction. This preparation when required should be freshly made.

Dose.—½–1 fluidounce (15.0–30.0 Cc.), in sweetened water.

Official Preparation.

Līquor Fĕrri et Ammōnii Acetātis—Liquōris Fĕrri et Ammōnii Acetātis—Solution of Iron and Ammonium Acetate (BASHAM'S MIXTURE).—Described under *Preparations of Iron*.

Antagonists and Incompatibles.—The metallic sulphates, the salts of lead and silver, lime-water, the carbonates of potassium and sodium, and acids.

Synergists.—Spirit of nitrous ether, potassium citrate, and many of the refrigerants and diaphoretics.

Physiological Action and Therapeutics.—Solution of ammonium acetate is both a mild diaphoretic and diuretic, according as the action is governed by other more powerful agents. For instance, if the skin is warm and the cutaneous blood-vessels dilated, the preparation acts as a diaphoretic, while if the condition of the skin is the reverse, the action of the drug is directed to the kidneys. Should the preparation be given with aconite or spirit of nitrous ether, its action would be that of a diaphoretic, but if the drug were associated with digitalis or squill, it would act as a diuretic. In any case the action of the drug is due to a stimulation of the secretory cells or nerves.

The principal medical use of solution of ammonium acetate is as a diaphoretic in febrile conditions, such as *acute coryza*, *influenza*, *acute pharyngitis*, etc. It is a very efficient remedy in *muscular rheumatism*, and in the *eruptive fevers* when the eruption is retarded. It is frequently associated with other remedies in the treatment of *scarlatinous dropsy*.

Owing to its property of stimulating the heart and circulation, the remedy has been recommended in low forms of fever, in the belief that it helps to sustain the powers of life, in lowering the pulse and temperature, moistening the tongue, and quieting the delirium.

In *migraine* and in *alcoholic intoxication* few remedies are so successful, the drug frequently dissipating the effects of acute alcoholism at once.

The remedy has been found efficacious in *dysmenorrhea* and *menorrhagia*, and has been employed externally and locally as a discutient in *mammary engorgements*, *glandular swellings*, *contusions*, *incipient abscesses*, etc.

Administration.—The preparation, as has been said, should be freshly made when wanted, and should be administered well diluted with sweetened water.

Spĭritus Ætheris Nitrōsi—Spĭritus Ætheris Nitrōsi—Spirit of Nitrous Ether. *U. S. P.*

(SWEET SPIRIT OF NITRE.)

Origin.—An alcoholic solution of ethyl nitrite, yielding, when freshly prepared and tested in a nitrometer, not less than eleven times its own volume of nitrogen dioxide.

Description and Properties.—A clear, mobile, volatile, and inflammable liquid, of a pale-yellowish or faintly greenish-yellow tint, having a fragrant, ethereal, and pungent odor free from acridity, and a sharp, burning taste. It should be kept in dark amber-colored, well-stoppered bottles, remote from lights and fire.

Dose.—½–2 fluidrams (2.0–8.0 Cc.).

Antagonists and Incompatibles.—The incompatibles are potassium iodide, ferric sulphate, antipyrine, mucilage of acacia, tincture of guaiacum, and gallic and tannic acids.

Synergists.—Diaphoretics, diuretics, antispasmodics, tincture of aconite, potassium citrate, etc.

Physiological Action and Therapeutics.—When applied to the skin and allowed to evaporate, spirit of nitrous ether produces a slight anesthetic effect. Internally, its action is very similar to that of the ammonium acetate. It dilates the blood-vessels more than the latter preparation, besides being more of a diffusible stimulant, stomachic, and carminative.

Like the solution of ammonium acetate, spirit of nitrous ether acts either as a diaphoretic or diuretic, the effect depending upon the manner in which it is administered. For its diuretic action it should be given in ice-water and the patient kept cool; to produce diaphoresis its administration should be accompanied by warm drinks and the patient be well covered.

Spirit of nitrous ether is used for about the same purposes as the solution of ammonium acetate, being particularly serviceable in *febrile affections* to promote critical sweating, employed either alone or in combination with tincture of aconite. It is frequently given as a diuretic in *Bright's disease*, *congestion of the kidneys*, and painful affections of the *urinary apparatus*.

It is a serviceable remedy to relieve *flatulent* distention of the stomach, to allay *nausea*, and to quiet *nervous agitation*. As an antispasmodic the remedy is frequently employed to relieve the pain of *dysmenorrhea*, and it may be inhaled for the relief of *coughing*. It enters into many expectorant mixtures, and is a soothing application to the forehead in *neuralgic headache*.

Administration.—The dose and manner of administering spirit of nitrous ether depend upon the action desired. As an antipyretic in febrile affections it should be given in doses of 20–30 minims (1.30–2.0 Cc.), in sweetened water, every half-hour. To produce diuresis the drug should be associated with some other diuretic and given in larger doses, ½–1 fluidram (2.0–4.0 Cc.), every three or four hours. If the remedy is desired for its diaphoretic action, it should be given in hot water, in doses of 20 or 30 minims (1.3–2.0 Cc.), repeated every half hour, the patient being well covered.

Should the drug be given as a nervous stimulant, the dose should not be less than 1 fluidram (4.0 Cc.).

Care should be exercised in the selection of spirit of nitrous ether that it be reliable and of full strength. If the preparation has been kept in large bottles exposed to light and air, the drug will be more or less inert and should not be prescribed.

MINERAL ASTRINGENTS.

ASTRINGENTS are medicines which cause the contraction of living tissues, diminishing the amount of blood or other fluid in them, and reducing hemorrhage, or, through their constipating action, limiting the intestinal secretions as well as those from mucous membranes generally.

They act chemically upon the tissues, and when taken internally, their influence is similar to that of tonics, their principal use being in cases of relaxed conditions of the muscles and fibers or of the mucous membranes characterized by excessive secretion.

Astringents are more or less irritating, and should therefore not be employed, as a rule, in acute inflammatory conditions. There are, however, four exceptions—lead acetate or subacetate, bismuth subnitrate or subcarbonate, cerium oxalate, and silver nitrate—which are sedative astringents and would be indicated in acute inflammatory states.

Astringents are divisible into (1) mineral astringents; (2) vegetable astringents.

A large number of the heavy metals, while they have a profound influence on the nutritive processes, are not known to possess any beneficial action, but rather so depress metabolism as to be more harmful than useful. They are employed, however, very widely for their local astringent and antiseptic effects.

They are silver, copper, lead, zinc, aluminum, cerium, and bismuth.

The astringent and escharotic actions of all of the metals are prominent. Such actions depend, however, in the dissociable salts, upon both ions of the compound, the acid as well as the metal. From the standpoint of the metal they vary in strength of action widely; thus, the series, from strongest to weakest, is: mercury, tin, silver, copper, zinc, iron, aluminum, and lead. For the acid ion, from most to least active, hydrochloric, nitric, sulphuric, oxalic, tartaric, citric, acetic acids. Thus, a combination of an active metallic ion, such as Hg, with an active acid, Cl, produces the very corrosive $HgCl_2$, corrosive sublimate, while lead acetate, the combination of the two mildest metal and acid ions respectively, produces a mild astringent salt. The chlorides of the heavy metals are usually soluble in water. Should a chloride be insoluble in water, it will not act as a caustic—as, for example, the insoluble, and consequently inert, silver chloride.

By a proper regulation, therefore, of acid and metal, almost any grade of action may be brought about. Thus, for definite dilutions and concentrations those—

(1) Compounds that are mainly astringent are: alum, lead acetate, zinc oxide, bismuth subnitrate, etc.

(2) Compounds that are astringent and caustic are: iron salts, zinc sulphate, zinc acetate, copper acetate, silver nitrate, lead nitrate, etc.

(3) Compounds which are mainly corrosive and caustic are: all mercury salts, zinc chloride, tin chloride, antimony chloride, copper sulphate, etc. Certain drugs which in a concentrated state are caustic are, if sufficiently diluted, astringent, as is the case with sulphuric acid.

An astringent drug employed to check hemorrhage is called a *styptic*, as, for example, the subsulphate of iron.

Certain salts of iron are powerfully astringent, although classed with iron under the Restoratives. Diluted sulphuric and nitric acids also possess marked astringent properties. (See MINERAL ACIDS.)

Inasmuch as many of these metals when taken for some time cause symptoms of chronic poisoning, they are here considered in greater detail.

Plŭmbum—Plŭmbi—Lead.

The salts of lead only are used in medicine, the official salts being as follows:

Plŭmbi Acētas—Plŭmbi Acetātis—Lead Acetate (U. S. P.) (SUGAR OF LEAD).—*Origin.*—Metallic lead is dissolved in the presence of air, in acetic acid, or lead oxide is dissolved by the aid of a gentle heat in acetic acid and water, the solution being filtered, evaporated, and crystallized.

Description and Properties.—Colorless, shining, transparent, monoclinic prisms or plates, or heavy, white, crystalline masses, or granular crystals, having a faintly acetous odor and a sweetish, astringent, and afterward metallic taste. On exposure to the air, efflorescent and absorbing carbon dioxide. Soluble in 2 parts of water and in 30 parts of alcohol, in 0.5 part of boiling water, and in 1 part of boiling alcohol. Lead acetate should be kept in well-stoppered bottles.

Dose.—½–5 grains (0.03–0.3 Gm.) [1 grain (0.065 Gm.), U. S. P.].

Līquor Plŭmbi Subacetātis—Liquōris Plŭmbi Subacetātis—Solution of Lead Subacetate (GOULARD'S EXTRACT).—Used externally and locally. (The solution contains not less than 25 per cent. of lead subacetate.)

Līquor Plŭmbi Subacetātis Dilūtus—Liquōris Plŭmbi Subacetātis Dilūti—Diluted Solution of Lead Subacetate (LEAD WATER).—Used externally and locally. (It contains 1 per cent. of lead subacetate.)

Cerātum Plŭmbi Subacetātis—Cerāti Plŭmbi Subacetātis—Cerate of Lead Subacetate (GOULARD'S CERATE).—Used externally and locally. (Goulard's extract, 20; camphor, 2; wool-fat, 20; paraffin, 20; white petrolatum, 38.)

Plŭmbi Iōdidum—Plŭmbi Iōdidi—Lead Iodide (U. S. P.).—*Origin.*—Obtained by mixing a solution of lead nitrate and potassium iodide, and drying the precipitate.

Description and Properties.—A heavy, bright-yellow powder without odor or taste. Permanent in the air. Soluble in about 1300 parts of water and in about 200 parts of boiling water, separating from the latter solution in brilliant golden-yellow spangles or crystalline laminæ. Very slightly soluble in alcohol, but soluble, without color, in solutions of the fixed alkalies, in concentrated solutions of the acetates, of the alkalies, potassium iodide, and sodium hyposulphite, and in a hot solution of ammonium chloride. Lead iodide should be kept in well-stoppered bottles.

Dose.—⅕ grain (0.013 Gm.).

Plŭmbi Nītras—Plŭmbi Nitrātis—Lead Nitrate (U. S. P.).—*Origin.*—Prepared by dissolving lead in diluted nitric acid.

Description and Properties.—Colorless, transparent, octahedral crystals, or white, nearly opaque crystals, without odor and having a sweetish, astringent, and afterward metallic taste. Permanent in the air. Soluble in 1.85 parts of water; almost insoluble in alcohol. Used externally and locally.

Plŭmbi Ŏxidum—Plŭmbi Ŏxidi—Lead Oxide (U. S. P.) (LITHARGE).—*Origin.*—Obtained by roasting lead in air.

Description and Properties.—A heavy, yellowish or reddish-yellow powder or minute scales, without odor or taste. On exposure to air it slowly absorbs moisture and carbon dioxide. Almost insoluble in water and insoluble in alcohol. Soluble in acetic or diluted nitric acid and in warm solutions of the fixed alkalies. Lead oxide should be kept in well-closed vessels. Used externally and locally.

Emplăstrum Plŭmbi—Emplăstra Plŭmbi—Lead Plaster (DIACHYLON PLASTER).—Used externally and locally.

(Lead oxide or lead plaster is contained in emplastrum ammoniaci cum hydrargyro and emplastra ferri, hydrargyri, opii, resinæ, and saponis.)

Unguĕntum Diăchylon — Unguĕnti Diăchylon — Diachylon Ointment.—(Lead plaster, 50; olive oil, 49; oil of lavender flowers, 1.) Used externally and locally.

Physiological Action.—Lead *per se* is practically inert; some of its salts, however, particularly the acetate, possess valuable therapeutic properties.

Externally and Locally.—Applied to the unbroken skin, solutions of lead salts have little, if any, effect, yet they act readily upon denuded surfaces, blanching the tissue of the parts by contraction of the small blood-vessels. They coagulate the albumin of the protoplasm of the neighboring superficial cells, and the coagulum being insoluble in an excess of the lead salt thus forms a protective coating for the healthier structure beneath.

These salts have likewise a sedative action because of the decreased local circulation. The nitrate alone is irritating because of the nitric acid ion.

Internally.—Digestive System.—Lead acts immediately in the mouth, causing a sweet, styptic taste and coagulating the mucus. It contracts the cells and vessels of the entire alimentary canal, inducing dryness by diminished secretion. Consequent to the disturbed physiological functions of the digestive tract, the peristaltic movements diminish, and constipation necessarily ensues.

In small amounts lead salts have practically no action on the various cerebral or medullary functions. In chronic poisoning these are markedly affected.

Absorption and Elimination.—The preparations of lead are converted in the stomach into albuminates; and thence taken up by the blood, very little absorption taking place in the intestine, where the lead is converted into an insoluble sulphide. It is absorbed by the abraded skin, and enters directly into combination with the albumin of the tissues. A portion of the lead albuminate is eliminated by the liver with the bile into the intestine, where, being converted into a sulphide, it is excreted in that form with the feces. The skin, kidneys, and mammary glands assist in its elimination.

Excretion is very slow, the liver and kidneys retaining lead for a long time.

Uterus.—Under the influence of lead, abortion is liable to occur or the child be still-born.

Untoward Action.—Undesirable results have followed the administration of medicinal doses of lead acetate, evidently arising

from insufficient elimination. Baker observed loss of appetite, gastralgia, constipation, and paralysis of three weeks' duration. This last symptom occurred in the hand of a man who had taken 1 grain (0.06 Gm.) of lead acetate twice daily for four days to relieve hematuria. In another case attacks of colic, lasting several months, followed the exhibition of 4 grains (0.25 Gm.) of the same salt for three days. Tanquére des Planches suggests caution in too free an administration of lead preparations, as being prone to occasion disagreeable symptoms. Hair dyes should be remembered in this connection.

The external application of lead solutions and ointments sometimes produces unpleasant effects, such as discoloration of the skin. In the mucous membrane lead rarely excites symptoms of poisoning, a single case being reported where lead water compresses were applied to the eye. Gastric pains have occurred after repeated applications of such compresses to a contused shoulder, the pains ceasing with their withdrawal and reappearing with a renewal of the treatment. Colic and paralysis of the member have followed washing of a large ulcer of the leg with lead water, these symptoms disappearing upon a withdrawal of the drug. In still another case a sweetish, styptic taste in the mouth and stiffness of the neck resulted from the external use of the solution.

Poisoning.—Acute poisoning from therapeutic doses is, fortunately, rare, the acetate—the form generally given—producing emesis, thus preventing toxic effects of the drug.

The first symptom of poisoning is a sweetish, metallic taste, soon followed by nausea and vomiting of a white, milky fluid containing curdy material—the result of a combination of the excess of lead with the hydrochloric acid of the gastric juice, and the formation of lead chloride. Constipation and subsequent diarrhea usually occur, with black passages, the discoloration being caused by the sulphide of lead formed in the intestinal canal. There is severe, persistent pain in the abdominal muscles, which are rigid and contracted, while a retraction of the abdominal walls is clearly perceptible. There are great thirst, and possibly cramps in the calves of the legs, neuralgic pains, muscular twitchings, vertigo, stupor, anesthesia, and paralysis. Tenesmus is present, and the face is pale and the lips vivid. As a rule, the liver is retracted and often diminished in size. The pulse is rapid and tense at first, becoming weak, compressible, and slow. 2 ounces (60.0 Gm.) of the acetate have caused death in three days.

Treatment of Poisoning.—Evacuation of the stomach is imperative, the process being more or less assisted by the emetic property of the drug. Some sulphate should be administered in order to form an insoluble lead compound. Epsom and Glauber's salts are the best antidotes, since they are readily soluble and easily obtained; acting, moreover, as purges, they empty the intestinal canal. Opium will serve to relieve pain and irritation, while to maintain bodily temperature hot applications can be used on the feet and abdomen.

Chronic Poisoning.—Chronic plumbism arises from a number of causes. The train of untoward symptoms is occasioned by long-continued medicinal use of lead preparations. Very frequent sources of poisoning are: drinking water conveyed in lead pipes, and foods colored with chrome yellow and those contained in cans soldered with lead. It is especially liable to occur among painters (colica pictonum), manufacturers of lead salts, color-grinders, and type-setters and founders. Hair dyes and cosmetics frequently cause lead-poisoning. Other sources are articles wrapped in tinfoil, cheap camp outfits, forks, plates and spoons, some glazed earthen-wares.

The symptoms develop with comparative uniformity, affecting chiefly the (1) intestines, (2) blood, (3) kidneys, and (4) nervous system. (1) The intestinal symptoms are those of local irritation, anorexia, constipation, dark feces, occasional diarrheal attacks, mouth tastes bad, smells badly, dark discoloration about the teeth (so-called lead line), particularly in those who do not keep the mouth clean. Colic usually develops after a short time—it often precedes a diarrheal attack. The intestinal spasms are exceedingly severe and come on with great suddenness.

(2) From the beginning there is an increasing grade of anemia. The red blood-cells degenerate, are pigmented, and the blood-making organs are also involved. The leucocytes may be increased or diminished. Pallor may become extreme.

(3) The kidneys almost invariably show granular degenerative changes. The urine is usually increased in amount, is of low specific gravity, usually contains albumin, granular and hyaline casts. The nephritis, originally parenchymatous in type, may become diffuse.

(4) The nervous symptoms are very variable. There is usually very early with the anemia and nephritis a persistent headache. The peripheral motor nerves are also affected and a multiple neuritis develops with extensive extensor paralysis. There is drop-wrist, drop-toe, etc. Usually bilateral, it may be unilateral. Pronation of the hand is possible, as the supinator longus is usually not involved in the paralysis. Sensory involvement is also possible. Anesthesiæ, paresthesiæ, sometimes neuralgic pains, occur. Arthralgias (gout-like) are not uncommon results of interference with the functions of the trophic nerves. Occasionally the nervous structures of the retina (amblyopia) are involved, either as a result of the albuminuria or as a direct poisoning by the lead. The brain itself may become affected. Acute delirious states may be induced, or there may be hallucinations with mental confusion and dementia and convulsive seizures of an epileptiform nature.

Treatment of Poisoning.—Removal of the poison is the first indication. The sulphates are given for their chemical and purgative effects, yet in chronic plumbism the hepatic purgatives—calomel, gamboge, jalap, etc.—are often preferable. Opium and morphine relieve pain and spasms, being claimed by some authorities as spe-

cifics in lead-poisoning. Sulphuric acid lemonade and plenty of milk have been found beneficial. Potassium iodide in 10-grain doses, three times daily, has an eliminative effect. Lead may be detected in the urine after giving iodides. This test should always be applied in suspected cases. The cerebral symptoms may be alleviated by a diaphoretic, such as pilocarpin or an alcohol sweat.

In progressive paralysis, strychnine is widely employed. Faradization of the muscles, if they respond, or otherwise galvanization, should be used to increase muscular force and prevent atrophy.

Therapeutics.—*Externally and Locally.*—Acetate being the typical lead salt, its action will be first considered. It acts as a sedative as well as an astringent in *acute inflammations*, such as *eczema* (not chronic), *impetigo*, *lichen*, and *erythema*; but it must not be used stronger than 10 grains (0.64 Gm.) to 1 ounce (30.0 Cc.) of water.

It is of service as an injection in *gonorrhea*, *leucorrhea*, *gleet*, and *otorrhea*. In combination with opium it makes a good topical application for *hemorrhoids*. As a gargle it is of some value, and is also serviceable in *orchitis*, *synovitis*, and *paronychia*.

Internally.—Its most important use is in *checking hemorrhages*, in which use it is associated with opium, although it is chemically incompatible with that drug. It is of service in *hemorrhage* in *typhoid fever*, *yellow fever*, *hemoptysis*, and *gastric ulcer*.

Morbid discharges, such as the *night-sweats* and *diarrhea of phthisis* and the *diarrhea of typhoid*, *dysentery*, *cholera infantum*, *secretions in bronchorrhea*, and *serous diarrhea*, are effectually checked by the acetate of lead and opium, which diminishes the pain, griping, and tenesmus attending the respective affections. By far its most frequent use, however, is in *serous diarrheas*, the drug acting very quickly and efficiently, and being both sedative and astringent.

Given in *chronic gastritis with pain*, lead acetate affords marked relief.

LIQUOR PLUMBI SUBACETATIS.—This preparation is used extensively for *bruises*, *sprains*, *acute eczema*, and as an application in *ecthyma*, *erysipelas*, and all kinds of *inflammations*; it should be well diluted. It also relieves the *itching of urticaria*, *pruritus pudendi*, and *eczema*.

A *felon* may sometimes be aborted, particularly if not deep, by saturating bread-crumbs with Goulard's solution, making a poultice, and placing it over the finger.

PLUMBI IODIDE.—Used very little. It acts beneficially when employed as an ointment applied to *enlarged lymphatic glands and spleen*; also for *psoriasis* and *chronic eczema*.

PLUMBI OXIDUM.—Hebryre commends an application of equal parts of lead plaster and linseed oil for *sweating of the feet*. It is chiefly used in the preparation of diachylon or lead plaster, emplastrum saponis and emplastrum resinæ being also prepared with the oxide.

Plumbi Nitras.—Used with good results in *onychia* and also in the manufacture of Ledoyne's disinfectant. It is an excellent remedy for *fissured nipples,* care being taken to wash the nipple before suckling. It destroys the *fetid odor* arising from *gangrenous sores* and *offensive discharges* from the *ears, nostrils, rectum,* and *vagina.*

Administration.—Locally a watery solution of lead acetate, 10 grains (0.64 Gm.) to 1 ounce (30.0 Cc.), is used. Powdered opium can be added, 1 dram to the pint of water. Applied to mucous membranes or used as an injection, 2 grains (0.12 Gm.) to 1 ounce (30.0 Cc.) of water, or 5 grains (0.32 Gm.) of the acetate and 5 grains (0.32 Gm.) of zinc sulphate in 1 ounce (30.0 Cc.) of water—rose water, for instance—proves a most efficient application. Suppositories for hemorrhoids may contain 1 grain (0.06 Gm.) of opium to 3–5 grains (0.19–0.32 Gm.) of the acetate. The pilulæ plumbi cum opio—lead acetate 3 grains (0.19 Gm.), opium 1 grain (0.06 Gm.)—is mostly used internally, one pill being taken every three hours. In dysentery and cholera infantum an enema containing 5 grains (0.32 Gm.) of lead acetate to 1 grain (0.06 Gm.) of opium, or ½ grain (0.03 Gm.) of morphine to 1 ounce (30.0 Cc.) of water, gives excellent results.

Should there be any abrasion of the skin, lead subacetate must not be used, as it prevents healing by constringing the edges of the wound.

Solution of subacetate of lead is most frequently used in union with opium, forming the well-known L. and L., or lead-water-and-laudanum, solution. It is also used in conjunction with glycerin, 1 ounce of each, or as Goulard's cerate, consisting of 20 parts Goulard's extract to 80 parts camphor cerate.

For ulcers, fissured nipples, and epithelioma lead nitrate is used, chiefly in the powdered form. In the nose, ears, vagina, and rectum a douche (2–5 grains (0.12–0.32 Gm.) to 1 ounce (30.0 Cc.) of water) is used. A solution of 10 grains (0.64 Gm.) to 1 ounce (30.0 Cc.) of glycerin or brandy is a very good application for sore nipples.

Zĭncum—Zĭnci—Zinc. *U. S. P.*

Origin.—Obtained by roasting the native zinc sulphide or carbonate, and reducing the resulting oxide with charcoal.

Description and Properties.—A bluish-white metal, showing a crystalline fracture and having a specific gravity ranging from 6.9 when it is cast to 7.2 after it is rolled. Soluble in diluted sulphuric or hydrochloric acid, with evolution of hydrogen gas.

Metallic zinc occurs in the form of thin sheets or in irregular, granulated pieces, or moulded into thin pencils, or in a state of fine powder.

Official Salts.

Zĭnci Acētas—Zĭnci Acetātis—Zinc Acetate.—*Origin.*—Obtained by dissolving zinc acetate in acetic acid and water and boiling: zinc acetate crystallizes out.

Description and Properties.—Soft, white, six-sided, monoclinic plates, of a pearly luster, having a faintly acetous odor and an astringent, metallic taste. Exposed to the air, the salt gradually effloresces and loses some of its acid. Soluble in 2.5 parts of water and 36 parts of alcohol. Zinc acetate should be kept in well-stoppered bottles.

Dose.—As a tonic, ½–2 grains (0.03–0.12 Gm.); as an emetic, 10–30 grains (0.6–2.0 Gm.); but principally used externally and locally [2 grains (0.12 Gm.), U. S. P.

Dose.—As a tonic, ½–2 grains (0.03–0.12 Gm.); as an emetic, 10–30 grains (0.6–2.0 Gm.); but principally used externally and locally [2 grains (0.12 Gm.), U. S. P.].

Zĭnci Carbōnas Præcipitātus—Zĭnci Carbonātis Præcipitāti—Precipitated Zinc Carbonate.—*Origin.*—Prepared by pouring together solutions of zinc sulphate and sodium carbonate, and drying the precipitated zinc salt.

Description and Properties.—An impalpable white powder, of somewhat variable chemical composition, without odor or taste; permanent in the air. Insoluble in water or alcohol.

Dose.—2–3 grains (0.12–0.18 Gm.). Chiefly used externally.

Zĭnci Chlōridum–Zĭnci Chlōridi—Zinc Chloride (U. S. P.).

A white, granular powder or porcelain-like masses. Very deliquescent. Not used internally.

Zĭnci Iōdidum—Zĭnci Iōdidi—Zinc Iodide.—*Origin.*—Prepared by dissolving zinc oxide or carbonate in hydriodic acid.

Description and Properties.—A white, granular powder, odorless, having a sharp, saline, and metallic taste. Very deliquescent and liable to absorb oxygen from the air, becoming brown from liberated iodine. Readily soluble in water, alcohol, or ether. Zinc iodide should be kept in small glass-stoppered bottles.

Dose.—½–2 grains (0.03–0.12 Gm.). Also used externally. [1 grain (0.065 Gm.), U. S. P.].

Zĭnci Ŏxidum—Zĭnci Ŏxidi—Zinc Oxide.—*Origin.*—Prepared by heating zinc carbonate to redness in a crucible.

Description and Properties.—An amorphous white powder without odor or taste. Insoluble in water or alcohol. It should be kept in well-stoppered bottles.

Dose.—¼–5 grains (0.015–0.3 Gm.).

Zĭnci Phenolsulphōnas—Zĭnci Phenolsulphonātis—Zinc Phenolsulphonate.—$Zn(C_6H_4(OH)SO_3)_2 + 8H_2O$, commonly known as zinc sulphocarbolate. It should contain not less than 99.5 per cent. zinc paraphenolsulphonate. $(C_6H_4(OH)SO_3)_2Zn$ 1 : 4 + $8H_2O$.

Description and Properties.—Colorless, transparent, rhombic prisms or tabular crystals, odorless, and having an astringent, metallic taste; effloresces on exposure and may become pink. Easily soluble in water or alcohol. The aqueous solution is acid to litmus.

Dose.—Average dose: 2 grains (0.12 Gm. = 125 milligrammes), U. S. P.

Zĭnci Stēaras—Zĭnci Stearātis—Zinc Stearate.—Used in preparing unguentum zinci stearatis, 50 per cent.

Zĭnci Sŭlphas—Zĭnci Sulphātis—Zinc Sulphate.—*Origin.*—Prepared by dissolving granulated zinc in sulphuric acid, certain precautions being taken to remove impurities.

Description and Properties.—Colorless, transparent, rhombic crystals, without odor, and having an astringent, metallic taste. Efflorescent in dry air. Soluble in 0.6 part of water and in 3 parts of glycerin; insoluble in alcohol. Zinc sulphate should be kept in well-stoppered bottles.

Dose.—1–3 grains (0.06–0.18 Gm.); as an emetic, 10–60 grains (0.6–4.0 Gm.). [15 grains (1 Gm.), U. S. P.].

Unguēntum Zĭnci Ŏxidi—Unguēnti Zĭnci Ŏxidi—Ointment of Zinc Oxide (20 per cent.).—Used externally and locally.

Zinci Valeras.—See Valerian.

Antagonists and Incompatibles.—The salts of zinc are incompatible with the vegetable astringents, alkalies and their carbonates, lime water, the sulphides, silver nitrate, lead acetate, and milk.

Physiological Action.—*Externally and Locally.*—The soluble zinc salts resemble the lead salts in their action, but they are less powerful astringents. They are also to a slight extent hemostatic. The chloride is exceedingly caustic. The insoluble zinc compounds are mildly antiseptic and astringent.

Internally.—*Digestive System.*—The sulphate of zinc and, in a slight degree, the carbonate are specific emetics, causing rapid emesis, with but little nausea or depression. It is believed that

their effects are due to local action on the stomach. Central nervous action may play a part in the emesis.

The salts of zinc also act as astringents upon the gastro-intestinal mucous membrane. Dyspepsia, constipation, or diarrhea frequently follow its ingestion even in small quantities.

Circulation.—Zinc salts, when introduced into the circulation directly, cause a depression of the heart's action, resembling in that, as in other regards, the action of copper, with which metal its general effects are most closely allied. The blood-pressure is affected but slightly. The pulse is somewhat slowed, especially just before death. With the blood, zinc forms new hemoglobin compounds (zinc-hemol).

Nervous System.—Zinc produces a depression of the central nervous system. When introduced intravenously, it may cause paralysis of the extremities.

Absorption and Elimination.—Zinc is taken up from the stomach and intestine and is found in largest quantities in the liver and bile. It is also found in the kidneys, pancreas, spleen, and thyroid. It is not held in the body in as stable a condition as the lead salts, and is less liable to bring about chronic poisoning. It is largely eliminated by the kidneys and bile. The salivary, milk, and intestinal secretions also eliminate some. In its passage through the kidneys zinc is an irritant, causing, in poisoning, a parenchymatous nephritis.

Untoward Action.—3–5 grains (0.19–0.32 Gm.) have produced nausea and gastric oppression, while if the zinc salt reaches the intestines diarrhea results. When taken on a full stomach the salts form an insoluble albuminate which undergoes the regular digestive process.

Repeated small doses, 3 grains (0.19 Gm.), have produced gastric oppression, eructations, slight confusion of thought, dizziness, bodily exhaustion, thirst, gastralgia, vomiting, and diarrhea. Zinc dyscrasia may follow, characterized by obstinate constipation, emaciation, and anemia.

Poisoning.—Continued use or excessive doses of zinc will produce poisoning, with symptoms resembling those of lead-poisoning.

Chronic Zinc-poisoning.—Among zinc workers there is a type of poisoning known as "*zinc-founders' fever*," or ague. The attacks frequently are acute. After pouring a mold the worker may have a sense of general distress, with backache and irregular muscular pains and lassitude. There is no disturbance of the pulse or of temperature. Shortly following this chills may develop, the pulse is increased to 100 or 120, and there are cough, pain in the chest, and headache. Profuse perspiration marks the climax of the attack, and the patient has labored sleep and recovers.

It is not improbable that the accompanying salts of arsenic and lead, always found in commercial zinc, are responsible, in part at least, for some of these symptoms.

Treatment of Poisoning.—Chemical antidotes are the bicarbon-

ates of soda and potassium. Flour and water, soapsuds, and milk are also beneficial. Morphine given hypodermically relieves the vomiting. Laxatives and potassium iodide may serve later to assist in eliminating the zinc.

Therapeutics.—ZINC OXIDE.—*Externally and Locally.*—The ointment or powder is used in *chronic eczema*, *intertrigo*, *burns*, *fissured nipples*, *anal fissure*, *ulcers*, and *skin diseases*. In combination with linseed oil the oxide has also been used in *erysipelas*. The drug has proved useful as an injection in *leucorrhea*.

Internally.—Associated with bismuth, sodium bicarbonate, or belladonna, it is very effective in *diarrhea*—particularly the *summer diarrhea of children*—and *dysentery*.

It is a most excellent remedy for *colliquative sweating* and the *sweating of phthisis*, and also serves to check the profuse secretion of *bronchorrhea*, although its use may occasion disordered digestion, since zinc is but sparingly soluble.

The oxide is valuable in *gastralgia*.

ZINC ACETATE.—It is used only externally and as an injection in *gonorrhea* and *leucorrhea*. In *conjunctivitis* it is useful as a collyrium.

ZINC SULPHATE.—*Externally and Locally.*—The external use is chiefly in *weeping eczema*, *pruritus*, and *ulcers*. Locally it is of service as a wash in *ophthalmia* and *conjunctivitis*, and as an injection in *gonorrhea*, *leucorrhea*, *vulvitis*, and *otitis*. It is also used in *gangrenous stomatitis*, *cancrum oris*, and as a gargle in *enlarged tonsils* and *relaxed sore throat*. In *nasal polypi* the powder is insufflated, the solution being applied to the stump after removal of the polypus. It dries up soft *tumors* near the vagina, anus, and female urethra.

Internally.—Its chief use is that of an emetic after ingestion of poison, irritating foods, and especially narcotics, as well as where the air-passages are obstructed, as in *croup* and *diphtheria*.

It acts as an astringent in *chronic diarrhea* and *dysentery* when associated with opium and ipecac.

ZINC CARBONATE.—This preparation is used only externally, for *blisters*, *weeping eczema*, and *intertrigo*. It is employed in the form of a powder, but generally as an ointment—CARDAMINE OINTMENT.

ZINC IODIDE.—This salt is but little used, but is of some value as a *gonorrheal* injection, as an application to *enlarged* and *indurated tonsils*, and in *scrofulous glands*.

ZINC PHOSPHIDE and ZINC VALERIANATE are used only for the benefit derived from the phosphorus and valerianic acid, and may properly be omitted here.

A long list of newer compounds of zinc have been given by the synthetic chemists. Some are of service, but they should be employed with understanding. The most important are the borate, chrysophanate, cyanide, gynocardate, hemol, zinc ichthyol, sulfonate, permanganate, salicylate, sozo-iodolate, stearate, subgallate, and sulphocarbolate.

Administration.—Externally the powder or ointment of zinc oxide is used, or the drug may be mixed with powdered starch, lycopodium, or acacia. Before applying these preparations it is well to wash the parts with a weak solution of carbolic acid.

Internally, ⅙ grain (0.01 Gm.) zinc oxide and 3 grains (0.19 Gm.) sodium bicarbonate are given in diarrhea, or, if preferable, bismuth subnitrate 10 grains (0.64 Gm.), pepsin (Sheffer's) 3 grains (0.19 Gm.), and zinc oxide ½–1 grain (0.03–0.06 Gm.), with a little opium added.

As an injection a combination of 10 grains (0.64 Gm.) each of zinc sulphate and lead acetate is used, the two salts interacting and producing lead sulphate—which is precipitated and insoluble—and zinc acetate.

Locally and externally the dry powder of zinc sulphate is used, or a mixture of zinc sulphate 10 grains (0.64 Gm.), aqua rosæ 4 ounces (118.29 Cc.), and glycerin 1 dram (4.0 Cc.), as a lotion. As an injection it is associated with lead acetate, forming the zinc acetate and lead sulphate. In *ophthalmia neonatorum* zinc sulphate 5 grains (0.32 Gm.), morphine sulphate 3 grains (0.19 Gm.), and aqua rosæ 1 ounce (30 Cc.), perhaps with atropine added, form an excellent mixture.

Internally, in dyspepsia 1–2 grains (0.06–0.12 Gm.) may be given, and for intestinal affections 1 grain (0.06 Gm.) each of the sulphate, powdered opium, and ipecac three times daily. To produce emesis 5 grains (0.32 Gm.) are sufficient.

The collyrium consists of ½ grain (0.03 Gm.) of the salt in 1 ounce (30 Cc.) of rose water.

COPPER.

Cūpri Sŭlphas—Cūpri Sulphātis—Copper Sulphate. *U. S. P.*

Origin.—Prepared by heating copper and sulphuric acid together, dissolving the soluble product in hot water, and evaporating.

Description and Properties.—Large, transparent, deep-blue, triclinic crystals, odorless, of a nauseous, metallic taste; slowly efflorescent in dry air. Soluble in about 2.6 parts of water and in 0.5 part of boiling water; almost insoluble in alcohol.

Dose.—⅛–½ grain (0.008–0.03 Gm.) [½ grain (0.03 Gm.), U. S. P.] as an astringent; as an emetic, 2–20 grains (0.12–1.2 Gm.) [4 grains (0.24 Gm.), U. S. P.].

Antagonists and Incompatibles.—Alkalies and their carbonates, the sulphides, mineral salts (except the sulphates), lime water, the iodides, and vegetable astringents.

Physiological Action.—Copper sulphate is the salt mostly used, and the only official preparation. Its action is therefore given as characteristic of that of cuprum.

Externally.—Applied to the unbroken skin it produces little effect, but on raw surfaces or mucous membranes it acts as an astringent. In large quantities it acts as a caustic. It also possesses antiseptic properties.

Internally.—*Digestive System.*—It acts as an irritant, causing

vomiting of greenish matter, though nausea does not follow the emesis. The secretions are augmented, and salivation and purging of blood and mucus are attendant consequences of its ingestion. Should emesis be delayed, the stomach should immediately be emptied, otherwise the copper is liable to produce inflammation.

Circulatory System.—Copper exists normally in the blood and acts as a tonic, being present in the circulation as an albuminate, or, as Kobert describes, a new compound, *cuprohæmal.* It depresses the heart's action, causing a small, weak, rapid pulse.

Nervous System.—It acts as a depressant.

Respiratory System.—Its influence is to hasten and depress the respiratory movements.

Absorption and Elimination.—Copper salts are slowly absorbed, tending to accumulate in the liver. The drug is eliminated by the liver, kidneys, salivary glands, and intestinal canal.

Poisoning.—Acute poisoning results from the inhalation of cupreous fumes, eating fruits cooked in copper vessels, or from an overdose of a copper salt.

When inhaled the first symptoms are those of bronchial catarrh and irritation. Internally administered, the symptoms do not usually appear at once, but after an hour's interval there are manifest a strong metallic taste in the mouth, burning and constriction of the pharynx and fauces, salivation and vomiting of greenish matter, and purging, the passages after a while containing mucus streaked with blood. There are present also burning in the epigastrium, and griping, colicky pains.

Copper enters the circulation quickly, it being highly diffusible. A characteristic symptom of poisoning is a green line on the gums. Sometimes jaundice may be present, and headache, convulsions, suppression of urine, cardiac depression, and hurried respiration are among the graver symptoms.

Treatment of Poisoning.—A chemical antidote should be given at once, potassium ferrocyanide being the best, as it forms an insoluble copper cyanide. Other recourses are white of egg, milk, sweet oil, emetics, and the use of the stomach-pump. A mustard plaster, with a little opium added to allay the pain and irritation, may be applied over the pit of the stomach as a counterirritant. Should vomiting have already occurred, emetics should be withheld.

Chronic poisoning is thought to result from long-continued use of the medicine or from taking minute quantities of copper as found in the many foods that are treated with copper salts. The acute symptoms are described the same as those of acute poisoning, with the following superadded: paresis of the limbs, paralysis, inco-ordination of muscles, atrophy of the liver, with fatty degeneration of the liver-cells, and proliferous growth of the connective tissue. There may also be present congestion of the lungs and fatty degeneration of the kidney, together with bronchial catarrh. It is by no means certain that these symptoms are due to the copper alone or to lead and arsenic, which are so frequently associated with it, par-

ticularly in foundries, etc., where these symptoms are noted. In view of the value of copper as a general disinfectant, the metal and its salts being markedly bactericidal, the question of chronic poisoning merits detailed investigation.

Therapeutics.—*Externally and Locally.*—COPPER SULPHATE stimulates *old, flabby, granulating ulcers. Ringworm, scabies,* and *tinea sycosis* derive great benefit from its use.

The crystal or solution, 2 grains to 1 ounce (0.12–32.0 Gm.) of water, is used extensively in *conjunctivitis, tinea tarsi,* and *trachoma condylomata,* and as a gargle in relaxed *sore throat.* The aphthæ in *aphthous stomatitis* are benefited by touching with the copper sulphate solution. It is also used as an injection in *gonorrhea* and *gleet,* 2 grains to 1 ounce (0.12–32.0 Gm.). It is also valuable in *mercurial sore mouth* and *gangrene of the pharynx.*

Internally.—COPPER SULPHATE is the chemical antidote for phosphorus-poisoning, yet it should be given with great caution, lest of itself it produce acute poisoning. It is a speedy emetic, since it acts directly upon the stomach. If emesis is not produced by the first dose, sulphate of zinc or mustard may be employed. It is used as an emetic in *croup.*

In *chronic dysentery* and *diarrhea* an enema of a pint of water (512.0 Gm.) and 10 grains (0.64 Gm.) of sulphate of copper is an efficient remedy, being by some authors considered the best metallic astringent in *chronic dysentery.*

Copper associated with arsenic is highly beneficial in *anemia.*

OLEATE OF COPPER is used in the skin affections mentioned.

NITRATE and ACETATE OF COPPER act like the sulphate.

ARSENITE OF COPPER has been suggested as a remedy in *anemia,* and has been used in doses of $\frac{1}{100}$ grain (0.0006 Gm.) in *diarrhea* and *cholera infantum.*

Administration.—For an enema in diarrhea and dysentery it may be combined with opium—2 grains to 1 ounce (0.12–32.0 Gm.) of water being used. For eye affections the crystal or solution is employed. In addition to the enema, copper sulphate, 1 grain (0.06 Gm.), may be united with magnesium sulphate 1 ounce (32.0 Gm.) and 1 dram (4.0 Gm.) of diluted sulphuric acid in 4 ounces (128.0 Gm.) of water, a tablespoonful of the mixture being given every three or four hours. To produce emesis 10–15 grains (0.6–1 Gm.) are dissolved in about 5 ounces (160.0 Gm.) of water, a tablespoonful being given every ten minutes until vomiting is produced.

SILVER.

Argĕnti Cyănidum—Argĕnti Cyănidi—Silver Cyanide. *U. S. P.*

Origin.—Obtained by distilling a solution of potassium ferrocyanide acidulated with sulphuric acid, the distillate passing into a receiver containing a solution of silver nitrate. The process should be continued until the distillate no longer produces a precipitate in the receiver. The precipitate is finally washed with distilled water and

dried. It should contain not less than 99.9 per cent. of pure silver cyanide, corresponding to 80.48 per cent. of metallic silver.

Description and Properties.—A white powder, without odor or taste; permanent in dry air, but gradually turning brown on exposure to light. Insoluble in water, alcohol, or cold nitric acid; soluble in boiling nitric acid, ammonia water, and solution of sodium hyposulphite or potassium cyanide. It should be kept in dark, amber-colored vials, protected from light. Not used internally.

Argĕnti Nītras—Argĕnti Nitrātis—Silver Nitrate. U. S. P.

Origin.—Obtained by dissolving silver in nitric acid with the aid of heat, evaporating, and crystallizing.

Description and Properties.—Colorless, transparent, tabular, rhombic crystals, becoming gray or grayish-black on exposure to light in presence of organic matter. Without odor, but having a bitter, caustic, and strongly metallic taste. Soluble in 0.6 part of water and in 26 parts of alcohol. It should be kept in dark, amber-colored vials, protected from light.

Dose.—¼–1 grain (0.015–0.06 Gm.) [⅙ grain (0.01 Gm.), U. S. P.].

Official Preparations.

Argĕnti Nītras Mitigātus—Argĕnti Nītras Mitigāti—Mitigated Silver Nitrate (MITIGATED CAUSTIC).—*Origin.*—Prepared by fusing together silver nitrate, 30, and potassium nitrate, 60, and casting in suitable molds.

Description and Properties.—A white, hard solid, generally in the form of pencils or cones of a finely granular fracture, becoming gray or grayish-black on exposure to light in the presence of organic matter; odorless, having a caustic, metallic taste, neutral to litmus-paper. It should be kept in dark, amber-colored vials. Used externally.

Argĕnti Nītras Fūsus—Argĕnti Nitrātis Fūsi—Molded Silver Nitrate (LUNAR CAUSTIC).—*Origin.*—Obtained by melting silver nitrate, 100, hydrochloric acid, 4, and pouring the melted mass into suitable molds.

Description and Properties.—A white, hard solid, usually cone- or pencil-shaped, of a fibrous fracture, becoming gray or grayish-black on exposure to light in presence of organic matter; odorless, having a bitter, caustic, and strongly metallic taste. Soluble in 0.6 part of water and in 26 parts of alcohol. The product should be kept in dark, amber-colored vials, protected from light. Used externally and locally.

Argĕnti Ŏxidum—Argĕnti Ŏxidi—Silver Oxide. U. S. P.

Origin.—Prepared by shaking a solution of silver nitrate with solution of potassa and washing the precipitate.

Description and Properties.—A heavy, dark, brownish-black powder, liable to reduction by exposure to light; odorless, with a metallic taste; very slightly soluble in water and insoluble in alcohol.

Dose.—½–2 grains (0.03–0.12 Gm.) [1 grain (0.065 Gm.), U. S. P.].

Antagonists and Incompatibles.—The silver nitrate is incompatible with the alkalies and their carbonates, chlorides, hydrochloric and tannic acids, potassium iodide, solutions of arsenic, and many of the organic acids.

Silver oxide is rapidly oxidized, forming explosive compounds with chlorides and organic substances.

Synergists.—Preparations of copper, lead, and zinc aid the action of silver salts.

The silver nitrate and its preparations and the silver oxide are the only salts which possess any value as astringents or caustics.

The silver nitrate is the typical astringent salt, and its physiological action will be hereafter considered.

Physiological Action.—Metallic silver is practically of no use in medicine, though of great value in surgery, because of its inertness. Silver nitrate is the salt of silver chiefly employed.

Externally and Locally.—It is a powerful caustic, but does not wound very deeply, as it forms an eschar by coagulating the albumin of the tissue, thus protecting the underlying structures. The eschar is white, but on exposure to light very soon becomes black, owing to the fact that the silver is reduced to its metallic state. The albuminate is soluble in chloride.

Like lead salts, silver salts are hemostatic. They are severely irritant to mucous membranes when used in solution. Soluble silver salts are actively bactericidal.

Internally.—Digestive System.—Weak solutions are astringent to mucous membranes, first contracting then dilating the blood-vessels. Stronger solutions are caustic. Weak solutions cause increased secretion of intestinal glands and larger flow of bile. The nitrate is frequently precipitated as the insoluble chlorides in the stomach and is later absorbed as an albuminate.

Silver salts have little or no action on the general functions of the body.

Absorption and Elimination.—It is absorbed from the stomach and eliminated very slowly, chiefly by the feces, a small portion being excreted by the kidneys.

Untoward Action.—Long-continued use of silver nitrate produces discoloration of the skin (argyria), either general or more pronounced in particular spots, such as the face. Even when the skin is perfectly intact the application of nitrate of silver will discolor it, and ¼ grain (.016 Gm.) has caused palpitation of the heart and irregular pulse. Silver accumulates in the tissues.

Poisoning.—A poisonous dose of silver nitrate produces a violent gastro-enteritis. The earliest symptom is an intense pain in the abdomen, followed by vomiting and purging. The abdominal muscles are hard and retracted, the face livid and covered with perspiration and wearing an anxious expression. The lips are blanched, gradually becoming black; the vomited matter is blackish and sometimes resembles milk-curds.

Epileptiform convulsions, delirium, and paralysis ensue, the latter symptom being of centric origin.

Death results from shock. A large amount of mucus is thrown into the bronchial tubes by the lining mucosa.

Treatment of Poisoning.—The chemical antidote is common salt. It is essential to protect the mucous membrane of the esophagus and stomach, and at the same time dilute the poison as much as possible, for which purposes large quantities of salt water and soap water or milk are valuable. Opium allays the pain and irritation.

Chronic poisoning, or argyria, results from prolonged medicinal use of silver nitrate or its employment as a hair-dye for any length

of time. The drug is deposited in all parts of the body, being especially manifest in a slaty, permanent discoloration of the skin. The first symptoms are discoloration of the sclerotic conjunctivæ and a dark line on the inner side of the lips. Ulcerative stomatitis may occur, or even gastric ulcer.

Treatment of Chronic Poisoning.—There is no known method of curing argyrosis when once developed. One hundred and fifty grains seem the limit. If more than this amount of the silver be given the discoloration is apt to occur. Considerable individual variation exists. Localized argyrosis has been known to occur after continued local applications of nitrate of silver to the larynx and pharynx.

Therapeutics.—*Externally and Locally.*—A very important use of SILVER NITRATE is that of preventing *ophthalmia neonatorum*, a 2 per cent. solution being dropped into the eyes. For adults a 2 to 4 per cent. solution is used in various forms of *conjunctivitis*, the eyelids being painted with a camel's-hair brush, and the solution being washed off immediately to prevent discoloration. The nitrate-of-silver stick may also be used.

Felons, *boils*, and *bedsores* may sometimes be aborted by the use of a strong solution—20 grains to 1 ounce—of SILVER NITRATE.

An injection of 2–3 grains (.12–.20 Gm.) to the pint is beneficial in *subacute gonorrhea* and *leucorrhea*. This may also be used as a wash in *pruritis ani* and *vulvæ*, to relieve the itching. The stick may be applied to uterine *ulcers*.

As a caustic it is used in *indolent ulcers* and *chancroids*, stimulating them and producing a healthy granulating surface.

After a cold, when the throat feels raw and sore, an application of 10 grains (0.6 Gm.) to the ounce (30.0 Cc.) is very beneficial, and the same may be used in *inflammations of the pharynx*, *fauces*, and *mouth*. A spray of 10 grains (0.6 Gm.) to the ounce (30.0 Cc.) is very effective in *laryngeal croup*, *tracheitis*, *chronic ulceration of the larynx*, and *whooping-cough*. The caustic pencil is used in *tonsillitis*, *sore nipples*, *mercurial sore mouth*, and *poisoned*, *lacerated*, and *punctured wounds*. A solution of 1–2 grains (.06–.12 Cc.) to the ounce (30.0 Cc.) is valuable in *otorrhea*, *vesical catarrh*, and *balanitis*.

Internally.—Dr. Pepper recommends this salt in *intestinal ulcerations*, given in keratin-coated pills. It is excellent for *gastric ulcer*, in which it may be combined with opium. *Gastralgia* and *chronic gastritis*, *ulceration of the rectum*, *dysentery*, and *diarrhea of typhoid* have been remarkably benefited by its use. For stomach affections $\frac{1}{6}$–$\frac{1}{4}$ grain (.01–.016 Gm.) is given, and for intestinal an enema of 3–10 grains (.20–.64 Gm.) to the ounce (30.0 Cc.).

It has been used in congested conditions of the cord, *locomotor ataxia*, *epilepsy*, and *chorea*. It is of no permanent value in any of these conditions.

ARGENTIC OXIDE is not so active as the nitrate. It has been employed for checking *sweats*, and, owing to its less caustic

action, it may be preferable to the nitrate in *gastric ulcer* and *gastralgia*.

Administration.—The dose of silver nitrate is $\frac{1}{6}$–$\frac{1}{4}$ grain (.01–.016 Gm.), and for a constitutional effect should always be given in pill form during the process of digestion.

The keratin-coated pill is to be administered for intestinal disorders, and when a local action on the alimentnry canal is desired an ordinary pill should be given one to two hours before meals.

It is well to discontinue the drug for a short time after three or four weeks treatment, the salt being so slowly eliminated that its prolonged use is very apt to result in argyria.

Newer Preparations of Silver.

Within recent years a number of new compounds of silver have been placed on the market. These have been devised to obviate, in part, the irritating effects of silver nitrate, as well as to avoid the limited action of this drug because of its property of coagulating proteids. Further, in internal therapy, since chlorides form insoluble compounds, these newer bodies have been made to avoid this chemical change. Among the more important of these may be mentioned: *Argentol*, *argonin*, *argentamin*, *protargol*, *largin*, *actol*, *itrol*, *ichthyargon*, and *colloidal silver* (collargolum).

Argentol.—This is a synthetic compound of quinaseptol and silver, which breaks up into oxychinolin and metallic silver. It is non-caustic, and is valuable in surgical wounds, skin affections, and has been employed in gonorrhea, but is not so valuable as protargol for this disease.

Argonin.—*Origin.*—A soluble compound of silver and casein, first prepared by Rohmann and Liebreich.

Description and Properties.—A dilute solution of this substance in water is opalescent; opaque when concentrated, but immediately cleared by the addition of ammonia or carbonate of soda. Used externally and locally.

Argentamine.—In order that a deeper action of silver might result, this solution of silver phosphate in aqueous solution of ethylendiamine was prepared. It was found, however, that the amine was too irritating, and this preparation has but limited application.

Protargol.—This product is the result of the attempt to obtain a compound of silver with an organic substance, albumose, which should be soluble and unirritating, and yet have the strong bactericidal properties of the metallic silver. It is a yellow powder, readily soluble in water, and contains 8.3 per cent. of silver. The solution is not affected by heat, albumin, hydrochloric acid, sodium chloride, or caustic soda. It is but slightly irritating, and has proved one of the best agents in the treatment of gonorrhea yet given to the profession. It is employed in from 2 to 10 per cent. solutions, depending upon the irritability of the affected parts and the stage of the disease.

Largin.—This is a compound of much the same character as protargol, being silver combined with protalbin (Danilewsky), a paranuclein proteid prepared by Lilienfeld. This proteid combination is a gray powder, soluble in 9 parts of water, containing 11.1 per cent. of silver, and is not precipitated by chlorides nor by albumin. It is used in much the same manner as protargol. It is used in ½ to 2 per cent. solutions.

Actol.—This is lactate of silver, a white powder, odorless, tasteless, and soluble in 20 parts of water. It has been recommended as an antiseptic, and fulfils much the same indications that silver nitrate does.

Itrol.—This is similar to actol, being the citrate of silver. It is much less soluble in water—1–4000. It has no advantages over the nitrate.

Ichthyargon is a combination of silver and ichthyol. Its position in therapy is not yet established.

Colloidal Silver (Collargolum).—Finely divided metallic silver was introduced by Crédé as an antiseptic in 1898. By the process of trituration metallic silver is converted into a soluble form, making, with water, a brownish solution. In this form it is used in internal hypodermic medication—½-1 per cent. (10–30 m.)—or the colloid silver is made up as an ointment.

The ointment should be rubbed into a part for from twenty to thirty minutes, and has been highly praised for the treatment of *lymphangitis*, *adenitis*, *boils*, *septicemia*, *erysipelas*, *puerperal fever*, or other septic process, local or general. Failure to obtain results is said by its supporters to be due to insufficient rubbing.

Much more extended observation is desirable before trustworthy conclusions may be drawn concerning the value of colloidal silver. It is desirable that the ointment be freshly made.

ALUMINIUM.

Alūmen—Alūminis—Alum. *U. S. P.*

Origin.—Prepared by a complicated process from a mixture of aluminum silicate and iron sulphide by roasting, lixiviating with water, concentrating the solution, and, while hot, mixing with potassium chloride. Upon cooling the alum separates as a crystalline powder, which is purified by one or two recrystallizations. It should contain not less than 99.5 per cent. of pure aluminum and potassium sulphate $Al.K(SO_4)_2 + 12\ H_2O$.

Description and Properties.—Large, colorless, octahedral crystals, sometimes modified by cubes, or crystalline fragments, without odor, but having a sweetish and strongly astringent taste. On exposure to the air the crystals are liable to absorb ammonia and acquire a whitish coating. Soluble in 9 parts of water and 0.3 part of boiling water; also freely soluble in warm glycerin. Insoluble in alcohol.

Dose.—5-40 grains (0.3–2.60 Gm.); as an emetic, 1–2 drams (4.0–8.0 Gm.) [7½ grains (0.5 Gm.), U. S. P.].

Official Preparation.

Alūmen Exsiccātum—Alūminis Exsiccāti—Dried Alum (BURNT ALUM).—*Origin.*—Alum heated until it is deprived of its water of crystallization.

Description and Properties.—A white, granular powder, without odor, possessing a sweetish, astringent taste and attracting moisture from the air. Very slowly but completely soluble in 20 parts of water, and quickly soluble in 0.7 part of boiling water.

Dose.—1–5 grains (0.06–0.3 Gm.).

Alūmini Hydrŏxidum—Alūmini Hydrŏxidi—Aluminum Hydroxide. *U. S. P.*

Origin.—This substance is found in nature as the rare crystalline mineral *gibbsite* of North America—the *diaspore* of Eastern Europe. The aluminum hydrate may be prepared by precipitating the solution of an aluminum salt with an alkali or alkali carbonate.

Description and Properties.—A white light, amorphous powder, odorless and tasteless, permanent in dry air. Insoluble in water or alcohol, but completely soluble in hydrochloric or sulphuric acid, and also in potassium or sodium hydrate T. S.

Dose.—3–6 grains (0.2–0.4 Gm.).

Alūmini Sulphăs—Alūmini Sulphātis—Aluminum Sulphate. *U. S. P.*

Origin.—It is occasionally found as an efflorescence near volcanoes and upon alum-slate. For medicinal use it should be prepared from aluminum hydrioxide, by dissolving it in the requisite quantity of dilute sulphuric acid.

Description and Properties.—A white, crystalline powder, having a sweetish and afterward astringent taste; permanent in the air. Soluble in 1.2 parts of water, and much more freely in boiling water; insoluble in alcohol. Used externally.

Allied Compounds.

Alumnol—Alumnol—Alumnol.—*Origin.*—This substance was discovered by Filehne of Breslau, and is a mixture of aluminum salts of naphthol-sulphonic acid, containing about 5 per cent. of aluminum and 15 per cent. of sulphur.

Description and Properties.—It occurs as a light, odorless, white or reddish-white, non-hygroscopic powder. It possesses a sweetish and astringent taste, and is readily soluble in water or glycerin, less so in alcohol, and insoluble in ether.

While becoming darker on exposure to the air, its properties are unaffected. Used externally and locally.

Aluminum Aceto-tartrate.—*Origin.*—First prepared by Athenstadt by dissolving 5 parts of basic aluminum acetate in a sufficient quantity of water by the aid of 2 parts of tartaric acid, and evaporating the solution to dryness.

Description and Properties.—It occurs in shining, almost colorless, amorphous masses, with a faint, acetous odor and an acidulous astringent taste. Soluble in water; insoluble in alcohol. Used externally and locally.

Aluminum Boroformate.—*Origin.*—Prepared by heating together boric acid, formic acid, and alumina.

Other combinations of aluminum are: *Alsol* (acetate), *Boral* (borotartrate), *Cutol* (borotannate), *Gallal* (gallate), *Sozal* (aluminum hydrate, dissolved in phenolsulphonic acid). *Salumin* (salicylate), and *Tannal* (tannate). They have the same indications as alumnol.

Antagonists and Incompatibles.—The alkalies and their carbonates; lead, mercury, and iron salts; tartrates and tannic acid.

Synergists.—The vegetable and mineral astringents.

Physiological Action.—*Externally and Locally.*—Alum contracts the small blood-vessels and coagulates the albumin in the tissues, but in order to have any effect it must be applied to a denuded surface. It is also mildly escharotic, particularly if anhydrous. The albuminate formed is soluble in an excess of proteid. Applied to the unbroken skin, it thickens and hardens it.

Internally.—Digestive System.—Its first effect when taken into the mouth is to excite the salivary secretion, the albumin in it, as well as that of the buccal mucous membrane, being precipitated. When its astringent action takes effect the secretions are diminished and the mucous membrane of the mouth and tongue is blanched and puckered. The enamel of the teeth is affected, breaking under its influence.

The digestive juices are diminished in quantity and the pepsin precipitated. Constipation follows, though it may be preceded by a slight diarrhea.

Taken in large doses, alum produces nausea, vomiting, purging, and abdominal pain.

Under ordinary conditions aluminum salts have no action on the general functions. Thrown into the circulation hypodermically they have a profound influence on the nervous structures, but such results are of experimental interest alone.

Absorption and Elimination.—As stated, alum is absorbed by the stomach and intestines; it is eliminated by the kidneys and liver.

Untoward Action.—The prolonged use of alum is very apt to produce a cough in persons having sensitive bronchi.

Therapeutics.—*Externally and Locally.*—ALUM is used to destroy *exuberant granulations* and *verrucosities*. It is an excellent hemostatic in *epistaxis* and bleeding from the *gums*, *vagina*, *rectum*, *bladder*, *bites*, and *sockets of extracted teeth*.

It is much used for *sore throat* by public speakers and singers, and is also efficient in *tonsillitis*, particularly the follicular form, *gangrenous pharyngitis*, *stomatitis ulcerosa*, *relaxation of the uvula and pharyngeal mucous membrane*, *swollen and overriding gums*, and *mercurial ptyalism*.

The destructive effect of alum upon the teeth must always be borne in mind: the alum stick or a swab is preferable whenever possible. If a mouth-wash or gargle be necessary, wash and brush the teeth well immediately after using the alum.

Five grains (0.32 Gm.) to 1 ounce (30.0 Cc.) of water is an excellent preparation for *ophthalmia*, *conjunctivitis*, and *trachoma*, but must not be used if there is any corneal inflammation, as it is apt to cause ulcers. By adding milk or white of egg to the mixture its efficiency is greatly increased. This preparation is also very serviceable in preventing the discoloration of a "black eye." An injection of 5–10 grains (0.32–0.64 Gm.) to the ounce (30.0 Cc.) of water is much used in *gonorrhea*, *leucorrhea*, and *gleet*, and also for washing the vulva in *pruritus*.

Sweating of feet, hands, and axillæ, when excessive and fetid, is checked by the application of a lotion of powdered alum.

Soaking a piece of cotton or lint with alum and placing it under an *ingrowing toe-nail* affords marked relief.

Chilblains, *old sores*, and *ulcers* are also benefited by the use of alum.

A spray, gargle, or insufflation has been used with good results in *diphtheria*, *bronchorrhea*, *chronic laryngitis*, *aphonia* due to atony, *bronchitis*, and *whooping-cough*.

Internally.—ALUM operates advantageously as an astringent in arresting *gastric* and *intestinal hemorrhages*, *hematuria*, and *menorrhagia*. The *diarrheas of typhoid fever*, and *chronic dysentery*, and occasionally the acute forms, are often benefited by an alum enema.

By checking absorption and producing emesis alum serves as an antidote for *lead-poisoning*, and is an efficient remedy in *lead colic*.

ALUMEN EXSICCATUM is employed chiefly as an escharotic for fungous growths, and to stimulate indolent *ulcers* and mucous membranes with morbid secretions.

Whenever the drug is used as a powder externally or for insufflation, powdered dried alum is the form to use.

Administration.—The emetic dose of alum is 1–2 drams (4.0–8.0 Gm.) in syrup. Warm water will increase its action when retching begins.

For internal use, 5–10 grains (0.32–0.64 Gm.), mixed with a little simple syrup or syrup of orange peel to prevent nausea, will be found beneficial. For collyria, 2–3 grains (0.12–0.20 Gm.) in 1 ounce (30.0 Cc.) of water, or the alum curd, as already mentioned,

may serve best. The curd may be separated by adding 2 drams (8.0 Gm.) of alum to 1 pint (473.0 Cc.) of milk, boiling, and straining.

The gargle and injection can be used in strengths of 5–20 grains (0.32–1.29 Gm.) to 1 dram (4.0 Gm.). For insufflation the dried alum is employed.

BISMUTH.

Bismūthi Cĭtras—Bismūthi Citrātis—Bismuth Citrate. *U. S. P.*

Origin.—Bismuth subnitrate and citric acid are boiled in sufficient water, and the precipitate washed and dried. It should contain not less than 58 per cent. nor more than 60 per cent. of pure bismuth oxide.

Description and Properties.—A white, amorphous or microcrystalline powder, odorless and tasteless, permanent in the air. Insoluble in water or alcohol, but soluble in ammonia water and in solutions of the citrates of the alkalies.

Dose.—1–3 grains (0.06–0.2 Gm.) [2 grains (0.125 Gm.), U. S. P.].

Official Preparation.

Bismūthi et Ammōnii Cĭtras—Bismūthi et Ammōnii Citrātis—Bismuth and Ammonium Citrate.—*Origin.*—Prepared by mixing bismuth citrate with distilled water to make a paste, adding sufficient ammonia water to make a solution, filtering, evaporating, and drying on plates of glass.

Description and Properties.—Small, shining, pearly or translucent scales, odorless, with a slightly acidulous and metallic taste, becoming opaque on exposure to the air. Very soluble in water, but sparingly soluble in alcohol. The product should be kept in well-stoppered bottles, protected from light.

Dose.—1–10 grains (0.06–0.6 Gm.) [2 grains (0.125 Gm.), U. S. P.].

Bismūthi Subcarbōnas—Bismūthi Subcarbonātis—Bismuth Subcarbonate. *U. S. P.*

Origin.—Obtained by dissolving purified bismuth in nitric acid and water, decanting and filtering, mixing with ammonia water, washing the precipitate, and dissolving in nitric acid. The solution is then mixed with a solution of sodium carbonate, and the resulting precipitate collected and washed. It should yield not less than 90 per cent. of pure bismuth oxide.

Description and Properties.—A white or pale yellowish-white powder, of somewhat varying chemical composition, odorless and tasteless, permanent in the air. Insoluble in water or alcohol, but completely soluble in nitric or hydrochloric acid, with copious effervescence.

Dose.—5–20 grains (0.3–1.2 Gm.) [7½ grains (0.5 Gm.), U. S. P.].

Bismūthi Subgăllas—Bismūthi Subgallātis—Bismuth Subgallate. *U. S. P.*

Definition.—Bismuth subgallate should yield not less than 52 per cent. nor more than 57 per cent. of pure bismuth oxide.

Official in the German Pharmacopœia as Bismutum Subgallicum; also known as *dermatol.*

Description and Properties.—Although somewhat variable in chemical composition, bismuth subgallate approximates the following formula: $C_6H_2(OH)_3CO_2Bi(OH)_2$, which contains 56.49 per cent. of bismuth oxide, Bi_2O_3. An amorphous, bright yellow powder, odorless, tasteless, and permanent in the air. Insoluble in water, alcohol, and in very dilute mineral acids. Readily soluble with decomposition in hydrochloric, nitric, and sulphuric acids, if these be heated. Alkalies dissolve it readily, forming clear, yellow-colored solutions, which rapidly change to deep red.

Dose.—Average dose: 4 grains (0.250 Gm. = 250 milligrammes), U. S. P.

Bismūthi Subnītras—Bismūthi Subnitrātis—Bismuth Subnitrate. *U. S. P.*

Origin.—Prepared by dissolving purified bismuth in nitric acid and water, concentrating by evaporation, adding more water, stirring well, and washing and drying the precipitated bismuth subnitrate. It should yield not less than 80 per cent. of pure bismuth oxide.

Description and Properties.—A heavy, white powder, of somewhat varying chemical composition, odorless and almost tasteless, permanent in the air. Nearly insoluble in water and insoluble in alcohol, but readily soluble in nitric or hydrochloric acid.

Dose.—5–20 grains (0.3–1.2 Gm.) [7½ grains (0.5 Gm.), U. S. P.].

Bismūthi Subsalicylas—Bismūthi Subsalicylātis—Bismuth Subsalicylate. *U. S. P.*

Definition.—Bismuth subsalicylate should yield not less than 62 per cent. nor more than 64 per cent. of pure bismuth oxide.

Official under the names of Bismutum subsalicylicum (P. G.), Bismutum salicylicum (Swiss), Bismuthi salicylas (Br. P.). The composition varies somewhat, but is approximately $C_6H_4(OH)CO_2BiO$.

Description and Properties.—A white, or nearly white, amorphous or crystalline powder, odorless, tasteless, and permanent in the air. It is almost insoluble in water; on prolonged boiling with water, a more basic salt is formed through the splitting off of free salicylic acid. Alcohol or ether extracts salicylic acid, with decomposition of the salt. Acids decompose it, with separation of a white, flocculent precipitate of salicylic acid.

Dose.—Average dose: 4 grains (0.250 Gm = 250 milligrammes), U. S. P.

Unofficial Bismuth Compounds.

A large number of bismuth compounds have been proposed for medicinal use in the last few years. The following may be mentioned as examples: **Airol** (bismuth oxyiodosubgallate), **bismal** (bismuth methylene digallate), **bismutol** ("bismuth sodium phosphate salicylate"), **crurin** (quinolin bismuth sulphocyanate), **iodogallicin** (bismuth oxyiodide methyl-gallol), other phenolates, the benzoate, the cinnamylate (**hetoform**), the cresolate, the lactate, the bilactomonotannate (**lactanines**), the phenolsulphonate, the tannate, and similar salts; also proteid compounds, as the peptonate; compounds with resorcin, pyrogallol (**helcosol**), etc.

Bismuth Naphtholate.—*Dose*, 15–30 grains (1.0–2.0 Gm.).

Bismuth Tribromphenate.—*Dose*, 60–75 grains (4.0–5.0 Gm.).

Dermol (BISMUTH CHRYSOPHANATE).—*Description and Properties.*—An amorphous yellow powder, neutral in reaction, insoluble in water or alcohol. Used externally and locally.

Thioform.—A combination of bismuth, sulphur, and salicylic acid.

Description and Properties.—A light, grayish-yellow powder, odorless and tasteless, insoluble in water, alcohol, or ether. Used externally and locally.

Xeroform.—Tribromphenolate of bismuth, containing 50 per cent. of Bi_2O_3. It is a yellow, neutral, insoluble powder, tasteless, odorless, and non-irritating. It is used in doses of 8–15 grains (0.5–1.0 Gm.) as an intestinal antiseptic. It is useful in fresh wounds, in gynecology, and in eczemas and prurigo.

Orphal.—Beta-naphthol bismuth, containing 7 per cent. of oxide of bismuth and 23 per cent. of beta-naphthol. It is a light-brown powder of pleasant taste, and splits up in the intestines into bismuth and beta-naphthol. It is used as an intestinal antiseptic in doses of 8–45 grains (0.5–3.0 Gm.).

Eudoxin.—This is a bismuth salt of nosophan (*q. v.*). It is used in the same way as xeroform.

There is a long list of other bismuth combinations, some of which may be found, after further observation, to be of service.

Antagonists and Incompatibles.—The salts of bismuth are insoluble, and should not be prescribed with other agents in solution.

Synergists.—The sedative action of bismuth upon the stomach may be increased by calomel and cerium oxalate, and pepsin may be given as a substitute for this purpose. The astringency of the bismuth salts may be enhanced by the addition of opium and tannic acid.

Physiological Action.—*Externally.*—Bismuth salts are mildly astringent, but have no appreciable physiological effect upon the unbroken skin.

Internally.—Digestive System.—Bismuth is insoluble in the gastro-intestinal juices. It coats the mucous membrane, lessening secretions and absorbing excess of free acids, at the same time acting as a sedative and feeble astringent. The tongue and stools are tinged a dark-clay color, due to conversion into the sulphide. The soluble salts are absorbed very slowly, and increase the appetite and digestion, constipation being the result.

In its general action bismuth is of interest only experimentally. In mammals intravenous injections of soluble salts cause slowing of the heart action, acceleration of the respiration, and irritative phenomena of the nervous system (convulsions).

Absorption and Elimination.—The salts of bismuth are absorbed into the circulation, and are eliminated by the urine, liver, and feces.

Untoward Action.—Odier noticed nausea, and Weenesk vomiting, colicky pains, diarrhea, or constipation, headache, sensation of heat, dizziness, and general debility.

Poisoning.—It has always been assumed that cases of poisoning are due to the lead and arsenic contained in the bismuth preparations, and few cases of poisoning are known from the internal use of bismuth. Local applications (dermatol) have given rise to gastro-intestinal irritation—salivation, sore gums, sloughing in the palate, etc. These symptoms disappear on removing the dressings.

Therapeutics.—*Externally and Locally.*—BISMUTH SUBNITRATE is serviceable in *intertrigo*, *erythema*, *acne rosacea*, as a protective dressing for *wounds*, *ulcers*, and *epithelioma*, and as an application for *chapped nipples* and *hands*, relieving the smarting and itching. It is also of use in *fissure*, *prolapsus ani*, and *superficial burns*.

It is used as an injection in *gonorrhea*, *leukorrhea*, and *ozena*, and was formerly used as an insufflation in *acute nasal catarrh*, being abandoned because of the arsenic which it sometimes contains. It serves as a wash in *aphthous stomatitis*, mild cases of *mercurial salivation*, and *cancrum oris*, as well as for the fetid *sweating of feet* and other parts, and for *chancres* and *phlegmonous erysipelas*. It has also proved beneficial in *chronic conjunctivitis* and *granular lids* or *trachoma*.

Internally.—It allays irritation, and is consequently useful in *irritative vomiting* and *diarrhea*. *Gastric pain* is relieved by it. It is valuable in *pyrosis*, *chronic diarrhea*, *gastric ulcer*, *chronic dysentery*, *diarrhea of typhoid*, early stages of *cholera* and *cholera infantum*, and in the *gastritis* due to alcohol.

The CITRATE OF BISMUTH AND AMMONIUM is very soluble, and should be used only for local applications.

The OXIDE is insoluble, and combined with morphine has been used as a snuff in *ozena* and *nasal catarrh*.

SUBCARBONATE OF BISMUTH is frequently used as an intestinal antiseptic.

SUBSALICYLATE OF BISMUTH reduces the pulse and temperature in *typhoid fever*, and also corrects fetid stools of indigestion diarrheas.

BISMUTH SUBGALLATE, or DERMATOL, was first used by Heintz and Liebreich, being intended as a substitute for iodoform; but it is very astringent, although not irritating. The preparation is used in *weeping eczema*, *otitis media*, *herpes*, *wounds*, *burns*, *diarrhea*, and *dysentery*. In *stagnant ulcers* it is of no service, since they need stimulation.

BISMUTH CITRATE is insoluble, and is of no service medicinally.

Besides the foregoing preparations there is a TANNATE OF BISMUTH, used to some extent in *diarrhea*, *gonorrhea*, *leukorrhea*, and *ophthalmia*.

PHOSPHATE OF BISMUTH is the least soluble of all the bismuth compounds, and is used, but rarely, in *diarrhea*, *dysentery*, *gastralgia*, and *dyspepsia*.

SUBIODIDE OF BISMUTH is used as a substitute for the subnitrate, and is of special value in *chronic ulcers*. It is supposed to be slightly anesthetic.

SUBBENZOATE OF BISMUTH is mildly escharotic.

Administration.—The drug is used externally as a powder or ointment in combination with naphthalin or vaseline, to which a little morphine may be added. Belladonna, opium, and oleate of bismuth are also used.

For gastralgia and dyspepsia, pepsin or magnesium and calcium phosphate may be combined with bismuth. If a cathartic is desirable, rhubarb may be added.

Bismuth, aromatic powder, and carbo ligni make an excellent combination in flatulent dyspepsia.

In infantile diarrhea and summer complaint bismuth 1 grain (0.06 Gm.), syrupus aurantii 15 minims (0.92 Cc.), and calumba 15 minims (0.92 Cc.) are efficacious, particularly as they allay the alternating pain. Large quantities of bismuth are advisable.

Bismuth, 5–15 grains (0.32–1.0 Gm.), is given for stomach affections, and 15 grains (1.0 Gm.) to 1 dram (4.0 Gm.) for intestinal disorders, one to two hours after meals as the stomach is emptied.

CERIUM.

Cērii Ŏxalas—Cērii Oxalātis—Cerium Oxalate. *U. S. P.*

(CEROUS OXALATE.)

Definition.—Cerium oxalate consists chiefly of a mixture of the oxalates of cerium, didymium, and lantharum, and of other rare metals of this group.

Origin.—Prepared by a complicated process by the action of acids, etc., upon the powdered mineral.

Description and Properties.—A white, granular powder, without odor or taste, and permanent in the air. Insoluble in water, alcohol, or ether.

Dose.—1–8 grains (0.06–0.5 Gm.) [1 grain (0.065 Gm.), U. S. P.].

Physiological Action.—The physiological action of this drug is imperfectly understood: it is supposed to be a nervous and gastric sedative.

Therapeutics.—*Internally.*—Its widest application is in the *vomiting of pregnancy*, but it also controls the *emesis of uterine disease* and of *dyspepsia*, due to gastric acidity or deranged innervation of the stomach, as in sea-sickness.

It does not derange digestion, and is therefore of value in checking the *cough of phthisis* and *bronchitis*, especially when accompanied by vomiting.

In combination with bismuth it is useful in checking *diarrhea*.

Administration.—Cerium oxalate is usually administered in pill form, 1–3 grains (.06–.20 Gm.) three times daily, but the powder is used when the drug is associated with other remedies.

VEGETABLE ASTRINGENTS.

Ăcidum Tănnicum—Ăcidi Tănnici—Tannic Acid. *U. S. P.*

Definition.—A monobasic organic acid, $C_{13}H_9O_7.COOH$, obtained from nutgall.

Description and Properties.—A light-yellowish, amorphous powder, usually cohering in the form of glistening scales or spongy masses; odorless or with a faint characteristic odor and a strongly astringent taste; gradually turning darker when exposed to air and light. Soluble in about 0.34 part of water and in 0.23 part of alcohol; very soluble in boiling water and in boiling alcohol; also soluble in about 1 part of glycerin with the assistance of a moderate heat; freely soluble in diluted alcohol and sparingly in absolute alcohol; almost insoluble in absolute ether, chloroform, benzol, or benzin.

Dose.—1–20 grains (0.06–1.2 Gm.) [7½ grains (0.5 Gm.), U. S. P.].

Official Preparations.

Collŏdium Stўpticum—Collŏdii Stўptici—Styptic Collodion.—Used externally and locally. (Tannic acid, 20; alcohol, 5; ether, 25; collodion, to 100.)

Glyceritum Ăcidi Tănnici—Glyceriti Ăcidi Tănnici—Glycerite of Tannic Acid.—Used externally and locally. (Tannic acid, 20; glycerin, 80.)

Trochisci Ăcidi Tănnici—Trochiscos (acc.) Ăcidi Tănnici—Troches of Tannic Acid.—*Dose*, 1–3 troches.

Unguĕntum Ăcidi Tănnici—Unguĕnti Ăcidi Tănnici—Ointment of Tannic Acid.—Used externally and locally. (Tannic acid, 20; glycerin, 20; ointment, 60.)

Antagonists and Incompatibles.—The vegetable astringents are incompatible with the salts of iron (ferric and ferrous), and also with the salts of lead, silver, antimony, and copper; with the alkaloids, the glucosides, and gelatin; and with the alkalies and mineral acids and emulsions. Spirit of nitrous ether is incompatible with gallic acid.

Synergists.—Tonics and bitters, and also agents increasing waste, favor the action of vegetable astringents.

Physiological Action.—*Externally.*—Tannic acid has little, if any, effect upon the unbroken skin. It is feebly antiseptic. Upon raw surfaces, however, it acts as a powerful astringent, contracting the tissues and coagulating the albumin. Urticaria and erythema sometimes follow its use. In weak solutions it tans dead skin. Locally applied to glandular structures, such as sweat glands, tannic acid causes a diminution in their secretions.

Internally.—Digestive System.—By coagulating the albumins tannic acid imparts a dryness to the mouth, accompanied by a sensation of puckering. It partially paralyzes the sensory nerve-

endings, thus blunting the sense of taste. Large doses produce vomiting by an irritant action, while diarrhea, followed by constipation, may be present.

By its action on the stomach, pepsin and peptones are precipitated, unless the stomach contents are markedly acid, albumin is coagulated, and the secretion of gastric juice diminished, all of which actions tend to impair the digestive function. The tannates formed are all susceptible of digestion, however, and tannic acid is set free. There is a partial conversion of the tannic acid into gallic and pyrogallic acids. To facilitate absorption there must be a preliminary conversion of tannic into gallic acid, and this reaction takes place in the intestine. A diminution of peristalsis is followed by constipation.

Circulatory System.—Its astringent property makes tannic acid a valuable hemostatic. It arrests hemorrhage partly by preliminary contraction of the blood-vessels, but more particularly by coagulating the proteid of the blood.

Nervous System.—No special effect has been observed.

Absorption and Elimination.—As tannic acid combines so readily with the proteids of the intestinal canal it is not absorbed, as a rule, in large amounts. Some of the ingested tannic acid is eliminated unchanged by the intestines. Most of it is converted into gallic acid in the intestines, and as such is eliminated by the urine and stools. The tannate that is absorbed may be found in the blood, possibly a sodium salt of tannic or gallic acids. Sodium tannate may be found in the urine. Much of the tannic acid taken up is completely oxidized.

Uterus.—No special influence other than arresting hemorrhage when locally applied has been noted.

Untoward Action.—A dose of 3 grains (0.2 Gm.) may cause pain in the stomach and intestines. Following such a dose, there may be coating of the tongue, thirst, eructation of gas, and tenesmus. A tendency to hemorrhoidal congestion is enhanced.

Therapeutics.—*Externally and Locally.*—TANNIC ACID is a valuable application for *bedsores* and *ulcers.* Its astringent property is of use in cases of *intertrigo, impetigo, sycosis, sore nipples,* and *eczema* of the *chronic desquamating variety.* It is beneficial in *hyperidrosis* of the *hands* and *feet,* of the *axillæ* and *genitals.*

The GLYCERITE OF TANNIN, applied locally in cases of *otorrhea* and *ozena* as sequelæ of scarlet fever or measles, is of some benefit. The same preparation or a powder may be used in *stomatitis, tonsillitis,* and *pharyngitis,* as well as in cases of *spongy* or *ulcerous gums.* The LOZENGES are beneficial in *whooping-cough.* SUPPOSITORIES OF TANNIC ACID are employed for *hemorrhoids, fissure, prolapse,* and *rectal ulcers.*

An AQUEOUS SOLUTION OF TANNIC ACID is very useful in *leukorrhea.* The glycerite and iodoform tannin are excellent agents in *inflammation of the cervix uteri.* TANNIC ACID also dispels the odor and allays the discharges in *carcinoma uteri,* being applied as a

vaginal douche. It is useful as a lotion in *herpes* and *alopecia circumscripta.* Injection of the acid or insufflation of the powder into the urethra is of some value in *gonorrhea.* In *acute dysentery* much benefit may be derived from an enema of 10 grains of tannin added to a 4 per cent. solution of boric acid. It lessens pain and tenesmus and controls hemorrhage.

Internally.—TANNIC ACID is styptic in *intestinal hemorrhage* and is valuable in treatment of *diarrhea.* It forms tannates when given as an antidote for poisoning by alkaloids and tartar emetic. Since these tannates are more or less soluble, however, some drug should be given as a purgative.

Administration.—For hematemesis powders of 10–20 grains are given. For effect upon the intestines it should be administered in pills, 3–5 grains, or it may be dissolved in the stomach. Locally it may be applied as a solution, glycerite, powder, suppository, or an ointment. Styptic collodion is a protection to lacerated or incised wounds.

Organic Combinations of Tannin.

Because of its irritating properties in the gastro-intestinal canal, tannic acid has been largely supplanted by a number of organic combinations. Among these are *tannalbin*, *tannigen*, *tannoform*, *tannon* (tannopin), and *tannocol.*

Tannalbin.—This is a compound of tannin and albumin, heated to 120° F. It is obtained as a red-brown powder, and is decomposed by the alkaline secretions of the intestinal canal and not by the gastric juice. It is one of the best of these newer compounds in the treatment of intestinal diarrhea if such diarrheas call for astringent action. The dose of tannalbin is from 45–150 grains (3–10 Gm.) for adults, children in proportion.

Tannigen.—This is a yellowish-gray powder—an acetic ester of tannic acid. It is odorless and tasteless, hygroscopic, insoluble in water, and slightly soluble in ether and alcohol. It acts best in the alkaline secretions, and is not acted on, or but slightly (Rost), by the gastric secretions. It is useful as an intestinal astringent in chronic diarrheas in about the same dosage as tannalbin.

Tannoform.—This is a product of condensation formed by the action of formaldehyd on gallotannic acids. It is a pale rose-colored powder, insoluble in water and soluble in alkaline solutions. It is valuable in diarrheas associated with much fermentation, and is also used as a topical application (as 10 per cent. ointment) in ozena, burns, hyperidrosis, pruritus, and hemorrhoids. Its dose internally is from 5–8 grains (0.25–0.5 Gm.). A number of tannoforms may be formed from the vegetable astringents, such as rubus, juglans, rhatany, catechu, quercus, etc.

Tannon, also called *tannopin,* is a combination of urotropin and tannin. It is a light-brown powder, insoluble in water and soluble in weak alkaline fluids. It has been recommended in diarrhea in 15-grain doses (1 Gm.).

Tannocol.—This combination of tannic acid and gelatin is practically identical with tannalbin.

Ăcidum Găllicum—Ăcidi Găllici—Gallic Acid. *U. S. P.*

Definition.—An organic acid, $C_6H_2(OH_3)COOH + H_2O$, usually prepared from tannic acid.

Description and Properties.—White or pale fawn-colored, silky, interlaced needles or tricolinic prisms; odorless, having an astringent or slightly acidulous taste; permanent in the air. Soluble in 87 parts of water and in 4.14 parts of alcohol at 25° C.

Dose.—5–20 grains (0.3–1.2 Gm.) [15 grains (1 Gm.), U. S. P.].

Physiological Action.—Gallic acid resembles tannic acid in its action, but does not coagulate albumin, and therefore does not possess the local influence of the latter.

Therapeutics.—*Externally and Locally.*—Gallic acid is seldom used externally. Locally, tannic acid is preferable, but gallic acid is effectual applied as a glycerite, 1 dram–1 ounce (4.0–32.0 Gm.), in cases of *tonsillitis* and *pharyngitis*. Gallic acid and stramonium ointment in equal parts form an unguent for *hemorrhoids*. In alcoholic solution it is applied to the membrane of *diphtheria*.

Internally.—It is doubtful if gallic acid has any distinct indications.

Administration.—Gallic acid is not to be combined with iron. It is administered in powder or pill form. The glycerite and the ointment are used locally.

Related Compounds.

Pyrogallic Acid is of use in *acne*, but produces a discoloration of the skin.

Eugallol and **Lenigallol**, acetates of pyrogallic acid, have been advised as substitutes of pyrogallic acid in psoriasis and acute and chronic eczemas.

Pyrogallol, 2 grains (0.12 Gm.), is used in *internal hemorrhage*. As an ointment, 1 dram to 1 ounce (4.0–32.0 Gm.), it is palliative in *psoriasis*, and it is also beneficial in *lupus* and *epithelioma*.

Gallanol, the analid of gallic acid, is a bactericide, and is useful in *psoriasis* in the form of a powder or in an ointment (1 to 30). It is also used in alcoholic solutions of 10 per cent. strength. It relieves the *pruritus of chronic eczema*. In *favus* and *trichophytosis* a mixture is used consisting of gallanol 10 parts, ammonia 1 part, and alcohol 50 parts.

Gallicine, methyl ether of gallic acid, applied in finely divided form with a brush, is a benefit in *keratitis* and *conjunctivitis*, as well as in *eczema of the eyelids*.

Gălla—Găllæ—Nutgall. *U. S. P.*

Origin.—An excrescence on *Quercus infectoria* Olivier, caused by the punctures and deposited ova of *Cynips tinctoria* Olivier.

Quercus infectoria is a small tree, or more often a shrub, 4 to 6 feet (1.2–1.8 M.) high, indigenous in the basin of the Mediterranean.

Description and Properties.—Nutgalls are subglobular, about 1 inch (25 Mm.) in diameter, more or less tuberculated above, otherwise smooth, heavy, hard; often with a circular hole near the middle communicating with the central cavity containing either the partly developed insect or pulverulent remains of it; inodorous; taste strongly astringent.

Galla in substance is seldom given internally.

Official Preparations.

Tinctūra Găllæ—Tinctūræ Găllæ—Tincture of Nutgall.—*Dose*, 1–2 fluidrams (4.0–8.0 Gm.) [1 dram (4 Cc.), U. S. P.].

Unguĕntum Găllæ—Unguĕnti Găllæ—Ointment of Nutgall.—Used externally.

Physiological Action.—Its action is that of tannic acid, which is derived from galls.

Therapeutics.—*Externally and Locally.*—GALLA, in combination with stramonium liniment or 1 dram (4.0 Gm.) of powdered opium to each ounce (32.0 Gm.) of nutgall ointment, is an excellent application for *external hemorrhoids*. For *eczema of the scalp*,

herpes, *fissured nipples*, *indolent ulcers*, and *chilblains* nutgall ointment has proved beneficial, as well as for *alopecia circumscripta* and *rectal prolapse*. One part of powdered galls to seven or eight of vaseline is a most excellent application for lessening the cicatricial contraction following extensive *burns*. Galla is used little locally, but is recommended as a gargle and wash, being applied to the relaxed mucous membranes of the mouth, vagina, and rectum.

Administration.—Galls are used mostly in the form of an infusion or ointment. The tincture is seldom employed.

Quĕrcus—Quĕrcus—White Oak. *U. S. P.*

Origin.—The dried bark of *Quercus alba* L., collected from trunks or branches ten to twenty-five years of age, and deprived of the periderm. The oaks are shrubs or trees growing chiefly in the temperate zone, often forming extensive forests. The white oak is a stately tree, 60 to 80 feet (18–24 M.) high, found from Canada to Florida and west to Wisconsin and Eastern Texas.

Description and Properties.—In nearly flat pieces deprived of the corky layer, about ¼ inch (5 Mm.), pale brown; inner surface with short, sharp, longitudinal ridges; tough and of a coarse, fibrous fracture, a faint, tan-like odor, and a strongly astringent taste. As found in the shops, it is usually an irregularly coarse fibrous powder, which does not tinge the saliva yellow.

Dose.—Seldom given in substance. A decoction is sometimes given internally, but the chief use of the drug is for external or local application.

Official Preparation.

Fluidextrăctum Quĕrcus—Fluidextrăcti Quĕrcus—Fluidextract of Quercus (U. S. P.).—Prepared from the official quercus (Quercus Alba, U. S. P., 1890), the bark of the white oak. The medicinal properties depend upon the tanni- contained in the bark.

Dose, —Average dose: 15 minims (1 Cc.), U. S. P.

Physiological Action.—The general action is that of tannic acid.

Therapeutics.—*Externally and Locally.*—It is used for *chapped nipples*, *gangrene*, *ulcers*, and *dermatatis venenata*. It is of value as an ointment in *hemorrhoids*, *prolapsus ani*, *anal fissure*, and *leucorrhea*. The drug is also serviceable in *relaxed uvula* and as a *tooth-powder*. It stains the linen, however, which somewhat limits its use. Pessaries made of the bark have been used to check *uterine hemorrhage*. For *scrotal hernia* the concentrated fluidextract is injected into the tissues for the purpose of exciting inflammation and consequent contraction of the hernial ring. It may be of service in diarrhea and dysentery.

Administration.—Externally it is used as a poultice—chiefly in the form of the powdered bark. The decoction is employed almost exclusively as an injection and for internal administration. The laity were formerly wont to roast the acorns and chew them, or grate them and mix the gratings with cocoa or chocolate, believing them to be a cure for diarrhea as well as for flatulent dyspepsia and scrofula.

Gămbir—Gambĭris—Gambir. *U. S. P.*

Definition.—An extract prepared from the leaves and twigs of *Ourouparia Gambir* (Hunter) *Bailion*. Both drugs contain a large percentage of tannic acid and its compounds. Gambir was introduced on account of the difficulty of obtaining in the market true Acacia catechu. The Tinctura Catechu Composita and the Trochisci Catechu (U. S. P., 1890) are replaced by tinctura gambiris composita and trochisci gambiris.

Description and Properties.—Irregular masses or cubes about 25 mm. in diameter, externally reddish-brown, pale brownish-gray or light brown; fracture dull earthy, friable, crystalline, inodorous, bitterish, very astringent, with a sweetish after-taste.

Dose.—Average dose: 15 grains (1 Gm.), U. S. P.

This takes the place of Catechu of the Pharmacopœia of 1890. Catechu is an extract prepared from the wood of *Acacia catechu* (natural order of Leguminosæ).

Official Preparations.

Tinctūra Gambĭris Compŏsita—Tinctūræ Gambĭris Compŏsitæ—Compound Tincture of Gambir.—*Dose*, ½–2 fluidrams (2.0–8.0 Cc.). (Gambir, 50; Saigon cinnamon, 25; by maceration and percolation with diluted alcohol to 1000.)

Trochĭsci Gambĭris—Trochĭscos (acc.) **Gambĭris—Troches of Gambir.**—*Dose*, 1–6 troches. (Each troche contains 1 grain (0.06 Gm.) of gambir.)

Physiological Action.—Gambir and catechu do not differ in their action from tannic acid. Both gambir and catechu depend on tannic acid for their activity. They show no variations in therapeutic activities. Being less soluble, their action on the intestines is more prolonged.

Kīno—Kīno—Kino. *U. S. P.*

Origin.—The inspissated juice of *Pterocarpus Marsupium* Roxburgh, a tree (called *buja* in Bengal) 60 to 80 feet (18–24 Mm.) high, indigenous in India and Ceylon.

Description and Properties.—Small, angular, dark-brownish red, and transparent; inodorous, very astringent and sweetish, coloring the saliva deep red. Soluble in alcohol, nearly insoluble in ether, and only slightly in cold water.

Dose.—10–20 grains (0.6–1.2 Gm.) [7½ grains (0.5 Gm.), U. S. P.].

Official Preparation.

Tinctūra Kīno—Tinctūræ Kīno—Tincture of Kino.—*Dose*, ¼–2 fluidrams (1.0–8.0 Cc.) [1 fluidram (4 Cc.), U. S. P.].

Pysiological Action.—Its action is similar to that of tannic acid. It colors the saliva, stools, and diapers red.

Therapeutics.—*Externally and Locally.*—Kino is an efficient dressing for *flabby, indolent ulcers*, acting as a stimulant. Yet the other astringents deserve precedence. As a gargle in *pharyngitis* and *relaxed uvula* kino is valuable, but, owing to its disagreeable taste, krameria is to be preferred. Owing to its speedy action it checks the hemorrhage in *epistaxis* where other astringents fail. In *leukorrhea* and *gonorrhea* an infusion or injection is serviceable.

Internally.—In *dysentery* and *chronic diarrheas* with profuse serous discharges. It is less irritating than the other astringents.

Administration.—The powder is used as an insufflation in epistaxis, and is dusted on ulcers. In diarrhea it is best to use kino in combination with opium or chalk mixture. The tincture is used internally.

Kramēria—Kramēriæ—Krameria. *U. S. P.*

Origin.—The dried root of *Krameria triandra* Ruiz et Pavon, *Krameria ixina* L., and of *Krameria argentea* Martine. Low shrubs with spreading branches, native to Bolivia and Peru, growing in sandy localities in the mountains at an altitude of 3000 to 8000 feet (900–2440 M.).

Description and Properties.—From 1 to 1½ inches (25–38 Mm.) thick, knotty, and several-headed above, branched below, the branches long; bark smooth, or in the thinner pieces scaly, deep rust-brown, $\frac{1}{25}$ to $\frac{1}{12}$ inch (1–2 Mm.) thick, very astringent, inodorous; wood pale, brownish-red, tough, with fine medullary rays, nearly tasteless. The root of *Krameria ixina* (Savanilla rhatany) is less knotty and slenderer, and has a dark purplish-brown bark about ⅛ inch (3 Mm.) thick.

Dose.—8–30 grains (0.5–2.0 Gm.) [15 grains (1 Gm.), U. S. P.].

Official Preparations.

Extrăctum Kramēriæ—Extrăcti Kramēriæ—Extract of Krameria.—*Dose*, 5–10 grains (0.3–0.6 Gm.) [7½ grains (0.5 Gm.), U. S. P.].

Fluidextrăctum Kramēriæ—Fluidextrăcti Kramēriæ—Fluidextract of Krameria.—*Dose*, 5–30 minims (0.3–2.0 Cc.) [15 minims (1 Cc.), U. S. P.].

Sȳrupus Kramēriæ—Sȳrupi Kramēriæ—Syrup of Krameria.—*Dose*, ½–4 fluidrams (2.0–16.0 Cc.) [1 dram (4 Cc.), U. S. P.].

Tinctūra Kramēriæ—Tinctūræ Kramēriæ—Tincture of Krameria.—*Dose*, ½–2 drams (2.0–8.0 Cc.) [1 dram (4 Cc.), U. S. P.].

Trochĭsci Kramēriæ—Trochĭscos (acc.) Kramēriæ—Troches of Krameria.—*Dose*, 1–5 troches. (Each troche contains 1 grain—0.06 Gm.)

Physiological Action.—The action of krameria is identical with that of tannic acid.

Therapeutics.—*Externally and Locally.*—Its value as a topical application is of little consequence, but it has served satisfactorily as an ointment for *hemorrhoids*. It is used as an infusion or injection of the diluted tincture or fluidextract in *leukorrhea*, *gleet*, and especially in *anal fissure*, for which it has been highly recommended, since it checks the accumulation of feces in the rectum by constricting its walls, rendering defecation less painful, and preventing the formation of ulcers. The powder is used in *epistaxis* and *rectal bleeding*, also in *prolapsus ani* and *ozena* of a non-specific nature. It is used extensively in the preparation of tooth-powders, being especially beneficial where the gums display a tendency to bleed readily. A mouth-wash and gargle are used in *ptyalism*, *spongy gums*, *pharyngitis*, and *relaxation of the uvula*. Krameria has gained a wide reputation for allaying habitual, but not profuse, *uterine hemorrhage*. It is a good tonic for debilitated patients. It is also used in *chronic diarrhea* and *dysentery*.

Administration.—The powder is used in the nose and rectum either by insufflation or by means of a pledget of cotton. As an injection and enema the fluidextract is used. In fissure of the anus the rectum must be emptied first by an enema; then a solution of the extract, 1 dram (4.0 Gm.) to 1 ounce (30.0 Cc.) of water, is emptied into the bowel and allowed to run out, repeating the process several times. This procedure is very painful at first, but as the fissure gradually heals the operation will cause the patient little, if any, pain. Keep the bowels open with a mild saline laxative. The success attending the operation warrants any discomfort which the patient may experience. The nasal douche is best in ozena, followed by an insufflation of the powder.

Hæmatŏxylon—Hæmatŏxyli—Hæmatoxylon. *U. S. P.*

(Logwood.)

Origin.—The heart-wood of *Hæmatoxylon campechianum* L., a tree 30 to 40 feet (9–12 M.) high, indigenous on the shores of the Gulf of Campeachy and in certain parts of South America.

Description and Properties.—Heavy, hard, externally purplish-black, internally brownish-red, marked with concentric circles, splitting irregularly; odor faint, agreeable, taste sweetish, astringent. When chewed it colors the saliva dark pink.

Only the preparations of hæmatoxylon are used externally.

Official Preparation.

Extrăctum Hæmatŏxyli—Extrăcti Hæmatŏxyli—Extract of Hæmatoxylon. —*Dose*, 5–15 grains (0.3–1.0 Gm.) [15 grains (1 Gm.), U. S. P.].

Physiological Action.—Its astringent properties are due to the tannin which hæmatoxylon contains.

Therapeutics.—*Externally and Locally.*—It is a valuable antiseptic, as well as a healing application in *gangrene* and *foul-smelling sores.* It is also beneficial as an injection in *leucorrhea.* Hæmatoxylon has a very agreeable, sweetish taste; hence it is well taken by children. It is of marked benefit in *infantile diarrhea*, but has the disadvantage of coloring the discharges and diaper blood-red or purplish blue, causing much alarm to the mother. The urine is also colored. It is used in *dysentery*, *tuberculous diarrhea*, and *atonic dyspepsia.* Some authorities claim that hæmatoxylon causes phlebitis.

Administration.—In diarrhea a decoction with a little aromatic sulphuric acid is the best preparation. To it may be added a little syrup of ginger and camphorated tincture of opium. The decoction is, in fact, the best preparation to use.

Hamamĕlidis Fōlia—Hamamĕlidis Foliōrum—Hamamelis Leaves. *U. S. P.*

(Witch-hazel.)

Origin.—The dried leaves of *Hamamelis Virginiana* L., a shrub 6 to 10 feet (1.8–3.0 M.) high, growing in damp woods and thickets in Canada and the United States.

Description and Properties.—Short-petiolate, about 4 inches (10 Cm.) long, obovate or oval, slightly heart-shaped and oblique at the base, sinuate-toothed, thickish, nearly smooth, inodorous; taste astringent and bitter.

Official Preparations.

Āqua Hamamĕlidis—Āquæ Hamamĕlidis—Hamamelis Water.—The final product here is a distillate, while the old Extractum Hamamelidis Fluidum is a percolate, now designated Fluidextractum Hamamelidis Foliorum. The aqua contains about 15 per cent. of the alcohol.

Dose.—Average dose: 2 fluidrams (8 Cc.), U. S. P.

Fluidextrăctum Hamamĕlidis Foliōrum—Fluidextrăcti Hamamĕlidis Foliōrum—Fluidextract of Hamamelis Leaves.—*Dose*, 30 minims (2 Cc.), U. S. P.

Hamamĕlidis Cŏrtex—Hamamĕlidis Cortīcis—Hamamelis Bark. *U. S. P.*

Both the bark and twig, and the leaves of *Hamamelis Virginiana* are now recognized by the Pharmacopœia; the former are introduced under the above title and the old hamamelis (U. S. P., 1890) becomes hamamelidis folia.

Dose.—Average dose: 30 grains (2 Gm.), U. S. P.

Physiological Action.—The action of tannic acid is also that of hamamelis, save that the latter has a somewhat different influence upon the circulation.

Circulatory System.—Hamamelis acts on the muscular fibers of the veins, the *modus operandi*, however, not being satisfactorily determined. Large doses produce severe throbbing headache and a sense of fulness of the blood-vessels.

Therapeutics.—*Externally and Locally.*—For *sprains* and *bruises* hamamelis is a favorite application, although some authorities regard it merely as a placebo. Locally, the FLUIDEXTRACT, with the addition of one-third its volume of glycerin, has been used in *urticaria*, *rhus-poisoning*, and *phegmasia dolens.* Owing to its marked sedative properties, HAMAMELIS OINTMENT is extremely beneficial in *varicose ulcers*, *eczema*, *herpes*, *seborrhea*, and *acne rosacea*, as well as in checking excessive secretions. It is also efficient in *carbuncle*, *hyperidrosis*, *lupus erythematosus*, *burns*, and *frost-bites.*

The local action of the drug is important. The DISTILLED EXTRACT, diluted with alcohol or water, is applied to *inflamed gums*, the nasal mucous membrane after removal of *polypi*, and in *pharyngitis* as a spray. As a SUPPOSITORY, or applied by means of a piece of cotton or wool soaked with the FLUIDEXTRACT, hamamelis affords a most grateful relief in *bleeding piles*, especially the internal variety. In *cystitis* and *hemorrhage from the bladder* an injection of the diluted FLUIDEXTRACT or DISTILLED EXTRACT is very valuable, besides being a most reliable topical application in *capillary hemorrhage* from wounds, *epistaxis*, and *bleeding* after extraction of teeth. The OINTMENT is used in *rectal fissures and ulcers*, and the LOTION has been employed to some extent in *chronic rheumatism*, since it relieves the pain and stiffness in the muscles and joints. The DECOCTION, with a little boric acid and a 1 per cent. solution of creasote, has been recommended as a *gonorrheal* injection.

Administration.—The best preparation, both for internal and external use, is the distilled extract, although it is not official. The ointment and lotion are used externally, and the fluidextract internally. The preparations of hamamelis to be found in drug stores are unreliable unless they be perfectly fresh.

Gerānium—Gerānii—Geranium. *U. S. P.*

(CRANESBILL.)

Origin.—The dried rhizome of *Geranium maculatum* L., a perennial herb with a stem 2 to 3 feet (30–60 Cm.) high, very common in Canada and the United States westward as far as Kansas.

Description and Properties.—Growth, horizontal, cylindrical, 2 to 3 inches

(5–7 Cm.) long and about ½ inch (1 Cm.) thick; rather sharply tuberculated, longitudinally wrinkled, dark brown; bark thin; wood-wedges yellowish, small, forming a circle near the cambium line; medullary rays broad, central pith large; roots thin, fragile, inodorous; taste strongly astringent.

Dose.—20–40 grains (1.2–2.40 Gm.) [15 grains (1 Gm.), U. S. P.].

Official Preparation.

Fluidextrăctum Gerănii—Fluidextrăcti Gerănii—Fluidextract of Geranium.—*Dose*, 20–40 minims (1.2–2.4 Cc.) [15 minims (1 Cc.), U. S. P.].

Physiological Action.—The action of geranium corresponds with that of tannic acid.

Therapeutics.—*Externally and Locally.*—Geranium is not used externally. Its local action is varied. It is serviceable as an astringent gargle in *sore throat;* as a mouth-wash in *aphthous stomatitis;* in *relaxed conditions* of the rectum, vagina, and throat; in *buccal ulcer*, *metrorrhagia* and *anal fissure;* in *prolapsus ani* and *epistaxis.* It has also proved valuable as an injection in *leucorrhea*, *gonorrhea*, and *gleet.* Owing to its mucilaginous taste, it is useful in *infantile diarrhea* and for persons having weak stomachs.

Administration.—Locally, the powdered root and fluidextracts are used, but the fluidextract diluted with water is preferable. For an injection a decoction, 1 ounce (32 Gm.) to 1–2 pints (512–1024 Gm.) of water, is used, and the decoction in milk is of service in infantile diarrhea.

Rhŭs Glābra—Rhōis Glābræ—Rhus Glabra. *U. S. P.*

(SUMACH.)

Origin.—The dried fruit of *Rhus glabra* L., a shrub or suffruticose plant about 12 feet (3.6 M.) high, growing in rocky or barren soil in North America.

Description and Properties.—Subglobular, about ⅛ inch (3 Mm.) in diameter, drupaceous, crimson, densely hairy, containing a roundish-oblong, smooth putamen; inodorous; taste acidulous.

Dose.—The preparations only are used internally.

Official Preparation.

Fluidextrăctum Rhōis Glābræ—Fluidextrăcti Rhōis Glābræ—Fluidextract of Rhus Glabra.—*Dose*, ¼–1 fluidram (1.0–4.0 Cc.) [15 minims (1 Cc.), U. S. P.].

Physiological Action.—The action of rhus glabra resembles that of tannic acid.

Therapeutics.—*Externally and Locally.*—An INFUSION or the FLUIDEXTRACT is used as a topical application for *ulcers* and *inflamed wounds.* The INFUSION is an excellent mouth-wash in *spongy gums*, *ptyalism*, *pharyngitis*, *aphthous stomatitis*, and *tonsillitis.* It can be used alone, but is much more efficient when combined with potassium chlorate and glycerin, adding a little menthol, 2–3 grains (0.12–0.20 Gm.), to make the mixture more agreeable. It is also of service as an injection in *leucorrhea.*

Administration.—The fluidextract is used exclusively.

Rōsa Găllica—Rōsæ Găllicæ—Red Rose. *U. S. P.*

Origin.—The dried petals of *Rosa gallica* L., collected before expanding.

Description and Properties.—Usually occurring in small cones consisting of numerous imbricated, roundish, retuse, deep purple-colored, yellow-clawed petals, having a roseate odor and a bitterish, slightly acidulous, and distinctly astringent taste.

Official Preparations.

Confĕctio Rōsæ—Confectiōnis Rōsæ—Confection of Rose.—Used as an excipient in pill-masses.

Fluidextrăctum Rōsæ—Fluidextrăcti Rōsæ—Fluidextract of Rose.—Used chiefly as a vehicle.

Physiological Action.—It acts like tannic acid.

Therapeutics.—*Externally and Locally.*—The OINTMENT is used for *chapped lips* and *hands*, and also for *superficial burns* and in *erythema.*

The FLUIDEXTRACT is used as an application to *inflamed eyes, buccal, aural,* and *anal ulcers,* and in *aphthous stomatitis.* It has been employed in conjunction with sodium salicylate to prevent the *pitting of small-pox.* Its chief use, however, is as a vehicle and flavoring extract.

Administration.—The fluidextract is mainly used, an infusion of which is given internally. The fresh leaves, crushed, are serviceable as a poultice.

Rūbus—Rūbi—Blackberry. *U. S. P.*

Origin.—The dried root-bark of the rhizome of *Rubus villosus* Ait., *Rubus nigrobaccus* Bailey, or of *Rubus cuneifolium* Pursh., common shrubby North American plants.

Description and Properties.—Thin, tough, flexible bands, outer surface blackish or blackish-gray, inner surface pale-brownish, sometimes with strips of whitish, tasteless wood adhering; inodorous; taste strongly astringent, somewhat bitter.

Official Preparation.

Fluidextrăctum Rūbi—Fluidextrăcti Rūbi—Fluidextract of Rubus.—*Dose,* ½–2 fluidrams (2.0–8.0 Cc.) [15 minims (1 Cc.), U. S. P.].

Physiological Action.—Identical with that of tannic acid.

Therapeutics.—*Internally.*—The fluidextract is used in the *summer diarrhea* of children—practically its only employment. An infusion of the leaves is claimed by Popoff to be an excellent remedy for *debility of the bladder.*

Administration.—The fluidextract and the infusion are used as medicinal agents. The syrupus rubi idæi is used only as a vehicle. Blackberry cordial and blackberry brandy are favorite modes of administration. It is commonly believed by the laity that the various blackberry and raspberry preserves are efficacious as remedies in diarrhea; on the contrary, they are highly irritating, because of the seeds present in them.

TOPICAL REMEDIES.

RUBEFACIENTS, VESICANTS, AND ESCHAROTICS.—These consist of a series of remedies that act directly upon the skin or mucous membrane, and are known by different names, according to the amount of irritation produced. Rubefacients, as the mildest, cause a redness of the skin with dilated blood-vessels; if their action is continued, local extravasation of serum beneath the epidermis may take place, forming a blister. If their action is more severe or if long continued, death of tissue may take place, thus causing a cauterizant action with the formation of an eschar. Emollients and demulcents have an opposite effect, in that they tend to allay or prevent irritative reactions on the part of the skin (emollients) or mucous membranes (demulcents).

RUBEFACIENTS.

These are drugs which, when locally applied, are intended to produce temporary redness and congestion of the skin. Some of them are vesicant if applied in full strength, and, if their contact with the skin be sufficiently prolonged, pustulation, or even total destruction of tissue, may result.

The following list embraces the principal rubefacient drugs:

Ammonia,
Alcohol,
Arnica,
Camphor,
Capsicum,
Chloroform,
Ether,
Iodine,
Menthol,
Mezereum,
Mustard,
Oil of cajuput,
Oil of turpentine,
Pitch,
Volatile oils.

Hot water and friction are also rubefacient agents.

Rubefacients are used for their influence upon the skin itself or for their effect on deep-seated structures.

Rubefacients are efficient means of relieving *neuralgic pains*, conditions of *nervous debility*, *nervous excitement*, the *sense of fatigue*, and as aids in *narcotic poisoning*, also to hasten the *absorption of inflammatory exudates*, to remove the swelling and restore the function of *chronically inflamed joints*, etc.

Rubefacients should ordinarily be applied with friction, as rubbing of the skin aids the action of many of them.

Save one, all the rubefacients mentioned in the preceding list have been considered elsewhere in the present work.

Mezerēum—Mezerēi—Mezereum. *U. S. P.*

Definition.—The dried bark of *Daphne mezereum* L., and of other European species of *Daphne*.

Description and Properties.—Long, thin bands, usually folded or rolled into disks, the outer surface yellowish or brownish yellow, with transverse scars and minute blackish dots, underneath of a light-greenish color; inner surface whitish, silky. Bast in transverse layers, very tough; inodorous; taste very acrid. The important constituent is an acrid resin, *mezerein;* an acrid oil resembling crotonoleic acid has been described.

Dose.—1–5 grains (0.06–0.3 Gm.) [7½ grains (0.5 Gm.), U. S. P.].

Official Preparation.

Fluidextrăctum Mezerĕi—Fluidextrăcti Mezerĕi—Fluidextract of Mezereum.—*Dose,* 1–5 minims (0.06–0.3 Cc.). Mezereum is also one of the ingredients in Decoctum Sarsaparillæ Compositum, Extractum Sarsaparillæ Fluidum Compositum, and Linimentum Sinapis Compositum.

Antagonists and Incompatibles.—The glucoside is precipitated by tannic and free acids, and the resin by water.

Synergists.—All the vegetable alteratives, with the exception of colchicum.

Physiological Action.—Its action, both locally and internally, is quite similar to that of sanguinaria, but when applied to the skin it is more of a vesicant than an escharotic, and taken internally it is more of a diuretic than sanguinaria, in poisonous doses causing severe urinary irritation and other symptoms produced by a violent gastro-intestinal irritant. The treatment of poisoning would be the same as that prescribed under poisoning by sanguinaria.

Therapeutics.—It is a counterirritant in the form of an ointment. Internally it is now seldom, if ever, used alone, but in combination with other vegetable specifics it is prescribed in *chronic rheumatism* and in *chronic syphilitic,* and *non-syphilitic, cutaneous diseases.*

Contraindications.—Acute inflammation of the stomach, bowels, and kidneys.

Administration.—As it is never given internally alone, no special instructions for its administration are necessary. The fluid extract freely diluted with water would, however, be the only preparation to use.

Xanthŏxylum—Xanthŏxyli—Xanthoxylum. *U. S. P.*

(Prickly Ash.)

Origin.—The dried bark of *Xanthoxylum Americanum* Miller or of *Fagara Clava-Herculis* (L.) Small. Both species are native to North America, the first being shrubby and attaining a height of 10 or 12 feet (3–3.6 M.), while the second species is a small tree sometimes 30 or 40 feet (9–12 M.) high.

Description and Properties.—*Xanthoxylum Americanum* (Northern Prickly Ash) occurs in curved or quilled fragments about $\frac{1}{25}$ inch (1 Mm.) thick; outer surface brownish gray, with whitish patches and minute black dots, slightly furrowed, with some brown, glossy, straight, two-edged spines, linear at the base and about ¼ inch (6 Mm.) long; inner surface whitish, smooth; fracture short, non-fibrous,

green in the outer, and yellowish in the inner, layer; inodorous; taste bitterish, very pungent. *Fagara Clava-Herculis* (Southern Prickly Ash) resembles the preceding, but is about $\frac{1}{12}$ inch (2 Mm.) thick, and is marked by many conical, corky projections, sometimes $\frac{4}{5}$ inch (2 Cm.) high, and by stout, brown spines rising from a corky base.

Xanthoxylum should not be confounded with the bark of *Aralia spinosa* L., which is nearly smooth externally, and beset with slender prickles in transverse rows.

Prickly ash contains an acrid green oil, a colorless, crystalline resin, a bitter principle, sugar, ash, and tannic acid.

Dose.—10–30 grains (0.6–2.0 Gm.) [30 grains (2 Gm.), U. S. P.].

Official Preparation.

Fluidextrăctum Xanthŏxyli—Fluidextrăcti Xanthŏxyli—Fluidextract of Xanthoxylum.—*Dose*, 10–30 minims (0.6–2.0 Cc.) [30 minims (2 Cc.), U. S. P.].

Physiological Action.—The action of xanthoxylum is quite similar to that of mezereum, though it is more of a stomachic tonic, sialagogue, diuretic, and diaphoretic, and not so much of a local irritant. It increases the heart's action and raises arterial tension.

Therapeutics.—It is used locally as a masticatory for the same purpose as mezereum, and the decoction has been highly recommended as a gargle in *chronic pharyngitis.* Internally it has no useful applications.

VESICANTS AND EPISPASTICS.

These are drugs which excite more or less local irritation when applied to the skin; the inflammatory condition is accompanied by an effusion of serum between the epidermis and dermis—*i. e.*, a *blister.*

The principal vesicants are:

Acetic acid (glacial),	Mezereon,
Ammonia (the confined vapor),	Mustard (volatile oil),
Cantharides,	Rhus Toxicodendron.
Iodine,	

There are certain drugs which affect certain parts of the skin—for instance, the orifices of the sudoriferous glands—in a special manner, and their action on these parts is such as to give rise to *pustules* rather than blisters. Drugs which affect the skin in this manner are called Pustulants. The following-named drugs are the most important of them:

Croton oil,	Silver nitrate,
Tartar emetic,	Ipecac.

Therapeutics.—Vesicants are employed as local stimulants in *chronic ulcers* and to facilitate the absorption of effusions, as in *chronic synovitis* or *chronic thickening about the joints.*

Blisters are also of use in *endocarditis*, *neuralgias*, *sciatica*, *chronic pericarditis*, *pleurisy*, *hysterical paralysis*, and *aphonia*, *cerebral* or *spinal meningitis*, etc.

PUSTULANTS are more particularly employed to maintain a continuous though moderate irritation in chronic inflammations. They are but rarely used for the same class of cases as vesicants, but are preferable when it is desirable to prolong the local irritation without exciting too much inflammation.

Contraindications.—Vesicants are usually contraindicated in *acute* inflammations and in inflammation of the cutaneous tissues, as rubeola and scarlatina. Vesicants are not permissible in pregnancy, debility, scorbutus, and purpura, or in extreme infancy and old age. They should not be applied over the scrotum or the mammary glands, nor over bony prominences where the healing processes are apt to be retarded.

Căntharis—Canthăridis—Cantharides. *U. S. P.*

(SPANISH FLIES.)

Origin.—*Cantharis vesicatoria* De Geer, a beetle indigenous to Southern and Central Europe, and found eastward as far as Western Asia. It should be thoroughly dried at a temperature not exceeding 40° C. (104° F.).

Description and Properties.—About 1 inch (25 Mm.) long and ¼ inch (6 Mm.) broad; flattish-cylindrical, with filiform antennæ, black in the upper part, and with long wing-cases and ample, membranous, transparent, brownish wings, elsewhere of a shining, coppery-green color. The powder is grayish-brown, and contains green shining particles. Odor strong and disagreeable; taste slight, afterward acrid.

Cantharides contains a fatty crystallizable body, *cantharidin*, supposedly related to benzol, which is the active principle, a volatile oil also possessing vesicatory properties, and a green oil closely allied to chlorophyl. Cantharidin is found in a number of beetles.

Used externally.

Dose.—½ grain (0.03 Gm.), U. S. P.

Official Preparations.

Cerătum Canthăridis—Cerăti Canthăridis—Cantharides Cerate.—Cantharides, 320; yellow wax, 180; resin, 180; lard, 170; liquid petrolatum, 150. Used externally.

Collŏdium Cantharidătum—Collŏdii Cantharidăti (60 per cent.)—**Cantharidal Collodion** (BLISTERING COLLODION).—Used externally.

Tinctūra Canthăridis—Tinctūræ Canthăridis (10 per cent.)—**Tincture of Cantharides.**—*Dose,* 1–5 minims (0.06–0.3 Cc.) [5 minims (0.3 Cc.), U. S. P.].

The cantharides cerate is an ingredient of **Emplastrum Picis Cantharidatum.**

Physiological Action.—*Externally and Locally.*—Cantharides is a slow though very powerful irritant. When the drug is applied to the skin or mucous membrane it excites a tingling, burning pain, with marked redness of the cuticle. In the course of three or four hours after the application of cantharides there are formed numerous vesicles which soon coalesce, forming one large bleb full of clear serum.

The drug not only causes vascular dilatation of the part to which it is applied, but reflexly dilates the blood-vessels of the deep-seated organs underneath, thus acting as a counterirritant.

The active principle of cantharides may be absorbed through the skin, producing its constitutional effects.

Internally.—Digestive System.—Moderate doses of cantharides

produce a sensation of heat in the stomach, and may even occasion gastrodynia. Large amounts occasion severe gastro-intestinal irritation. There is a sense of constriction in the esophagus, a burning heat in the throat, ptyalism, intense gastric pain, nausea, and vomiting of glairy mucus often containing blood. There is great tenderness over the abdomen, fibrinous and sometimes bloody stools, attended by griping pain and tenesmus.

Circulatory System.—Full medicinal doses excite the heart, increasing the force and rapidity of its action, and elevate arterial tension. Under large doses the pulse and arterial pressure fall, and there is great depression of the entire circulatory system.

Nervous System.—Small doses have no influence on the nervous system other than would be produced by stimulation of the circulation. Excessive amounts have produced marked cerebral effects, consisting of partial or general convulsions, coma, and insensibility.

Respiratory System.—No effect follows medicinal doses; toxic amounts accelerate and weaken the respiration.

Absorption and Elimination.—The active principle of cantharides is rapidly absorbed; as it is eliminated, produces marked irritation of the genito-urinary organs. There is at first increase of urine, which is soon greatly diminished in amount, and which may be albuminous or bloody. There is strangury and frequent desire to micturate, and severe pain in the loins and bladder. The local irritation is apt to occasion priapism, with frequently erotic excitement and seminal emissions. There may also be swelling and inflammation of the external genitals. In women cantharides may also occasion increased sexual desire, cause abortion, or induce menstruation. Yet amatory desire does not always follow the ingestion of cantharides, even in large doses. Indeed, the aphrodisiac effect of the drug is usually more manifest under small or full medicinal doses than from the ingestion of immoderate amounts. The drug is principally eliminated by the kidneys.

Temperature.—The temperature is at first elevated by excessive amounts, but declines together with the depression of the circulatory system.

Uterus.—The uterus and female genital organs are stimulated by the drug, as has been previously described.

Untoward Action.—The untoward manifestations do not differ from the symptoms produced by excessive amounts, as described under the different systems. These various untoward effects vary in intensity according to the individuality of the patient.

Poisoning.—Toxic amounts of cantharides produce violent gastro-intestinal and genito-urinary inflammation. The general symptoms are great pain in the throat, stomach, and bowels, excessive thirst, vomiting of bloody mucus, frequent stools which may contain blood, burning pain in the kidneys, strangury, scanty, albuminous, and bloody urine, painful erections of the penis, seminal emissions, swelling and inflammation of the external genitals, a rapid, small, and

weak pulse, accelerated respiration, skin hot and dry, congestion of the face, pain in the head, delirium, trembling, partial or general convulsions, and coma. The postmortem appearances are swelling, ecchymoses, and sometimes gangrene of the mucous membrane of the alimentary canal. The kidneys are enlarged and engorged, and are in a condition of parenchymatous and desquamative nephritis.

Treatment of Poisoning.—The stomach should be emptied, and demulcents, stimulants, and opiates given as necessary. Oils and fats should be avoided, as they increase the solubility and favor the absorption of cantharidin.

Therapeutics.—*Externally and Locally.*—A CANTHARIDAL BLISTER is frequently of service as a revulsive when there is a local tendency to congestion. The drug is applied to the chest in the second stage of *pneumonia* and in *pleurisy*, and "flying" blisters are beneficial in *hydrothorax* and *chronic pleurisy*.

The cure of *boils* and *carbuncles* has been hastened by applying a cantharidal blister to the indurated spot.

The drug is also of service to stimulate indolent *ulcers*, *fistulæ*, etc.

A blister over the region of the heart will often afford marked relief in *pericarditis*.

A CANTHARIDAL PLASTER applied over the course of the affected nerve frequently affords great relief from pain in *neuralgia* and some forms of *sciatica*.

In subacute or chronic inflammatory *diseases of the brain and spinal cord*, such as meningitis, blisters applied to the nape of the neck or along the course of the cord, a little to one side of the vertebræ, will often favorably influence the course of the disease.

Blisters are frequently of service in *synovitis* and *periostitis* of the larger bones. A blister applied to the epigastrium will sometimes allay *gastric pain* and *obstinate vomiting*.

Blistering over the region of the ovary is an efficient means of relieving the symptoms of *chronic ovaritis*, and a blister applied to the mastoid region will frequently be of benefit in *otitis media*.

Small patches of *tinea tonsurans* and of *tinea circinata* may be removed by blistering.

Liniments and lotions containing TINCTURE OF CANTHARIDES are among the best means of curing *alopecia*.

Internally.—Certain diseases of the genito-urinary organs, as *debility of the bladder* with accompanying *incontinence of urine*, *chronic pyelitis*, *chronic catarrh of the bladder*, etc., are benefited by small doses of TINCTURE OF CANTHARIDES.

Gleet, *prostatorrhea*, and *spermatorrhea* are benefited by this drug. *Menorrhagia* and *amenorrhea* occurring in debilitated women will often be benefited by cantharides.

Tincture of cantharides, with tincture of iron, tincture of nux vomica, and phosphoric acid, is a useful combination in *impotence*, the result of old age, sexual excesses, or masturbation.

In *scaly skin diseases* cantharides often proves very serviceable after arsenic and the external application of tarry preparations have failed.

Administration.—A cantharidal blister should not be allowed to remain on the skin for more than twelve or twenty-four hours, six to eight hours usually being sufficient. Care should be taken of the blisters, as they are apt to be infected very readily.

The obstinate ulcers which sometimes follow the use of cantharides blisters may be treated effectively by Goulard's cerate.

For internal use the tincture of cantharides is the only preparation to employ.

Sĭnapis Ălba—Sĭnapis Ălbæ—White Mustard. *U. S. P.*

Origin.—The seed of *Sinapis alba* L.
Dose.—120 grains (8 Gm.), U. S. P.

Sĭnapis Nīgra—Sĭnapis Nīgræ—Black Mustard. *U. S. P.*

Origin.—The seed of *Brassica nigra* (L.) Koch.

Both the white and black mustard are annual plants, indigenous in Southern Europe and Western Asia, cultivated, and sometimes found wild in the United States.

Description and Properties.—WHITE MUSTARD SEEDS are almost globular, about $\frac{1}{12}$ inch (2 Mm.) in diameter, with a circular hilum; testa yellowish, finely pitted, hard; embryo oily, with a curved radicle and two cotyledons, one folded over the other; free from starch; inodorous; taste pungent and acrid.

BLACK MUSTARD SEEDS resemble the preceding in shape, but have a diameter only of $\frac{1}{25}$ inch (1 Mm.); blackish-brown or deep reddish-brown, with a testa covered with shallow pits, and when crushed and macerated with water acquiring a strong and pungent odor.

WHITE MUSTARD SEEDS contain an almost tasteless, yellowish, fixed oil, and a glycoside known as *sinalbin*, which is the chief constituent. This substance may be converted into *sulphocyanate of acrinyl* (the volatile oil of mustard) by the action of the ferment *myrosin* and water:

$$\underset{\text{Sinalbin.}}{C_{30}H_{44}N_2S_2O_{16}} = \underset{\text{Volatile Oil.}}{C_6H_4(OH)CH_2NCS} + C_{16}H_{23}NOH_2SO_4 + C_6H_{12}O_6.$$

BLACK MUSTARD SEEDS contain the same fixed oil as the white mustard, and a glycoside, *sinigrin*, which by the action upon it of myrosin in contact with water converts it into *allyl isosulphocyanate* (a volatile oil):

$$\underset{\text{Sinigrin.}}{C_{10}H_{18}KNS_2O_{10}} = \underset{\text{Volatile Oil.}}{CSNC_3H_5} + C_6H_{12}O_6 + KHSO_4$$

To this volatile oil of mustard, which is official, are due both the pungent taste and odor of the moistened powder.

Dose.—1–4 drams (4.0–15.0 Gm.) [120 grains (8.0 Gm.), U. S. P.].

Official Preparation (of Black Mustard Seed).

Charta Sinapis—Chartæ Sinapis—Mustard Paper.

Ōleum Sĭnapis Volătile—Ōlei Sĭnapis Volătilis—Volatile Oil of Mustard. *U. S. P.*

Origin.—A volatile oil obtained from black mustard by maceration with water and subsequent distillation, yielding not less than 92 per cent. of allyl isothiocyanate.

Description and Properties.—A colorless or pale-yellow, limpid, and strongly refractive liquid, having a very pungent and acrid odor and taste. Freely soluble in alcohol, ether, or carbon disulphide. Used externally.

Physiological Action.—*Externally and Locally.*—Mustard is irritant, counterirritant, rubefacient, and vesicant. Any degree of irritation, from slight redness of the skin to severe blistering, may be produced by mustard. It is more rapid in its action than cantharides, and when applied to the skin there is produced almost immediately a sensation of warmth, which rapidly passes into a severe burning pain. This irritation of the sensory nerves is succeeded by paralysis and more or less loss of sensation, so that if mustard be allowed to remain on the skin until blistering ensues there is a decided diminution of pain.

The local application of mustard reflexly stimulates the heart and respiration.

Internally.—Mustard in small amounts is taken as a condiment, and is a powerful stimulant of the gastro-intestinal tract. Large doses irritate the stomach and act as an emetic, producing prompt emesis without depression, owing to the reflex stimulation of the heart and respiration.

The volatile oil of mustard is never intentionally given internally. It is a powerful caustic irritant, a single drop upon the tongue producing an intense burning pain in the throat, stomach, and nose.

Therapeutics.—*Externally and Locally.*—MUSTARD may be used locally for the same purposes as cantharides, being superior to the latter-named drug when a simple rubefacient effect is desired. Mustard when applied locally is more of a stimulant to the circulatory and respiratory systems than cantharides, and is therefore an efficient remedy in *syncope*, *asphyxia*, and *coma*.

As a stimulant in these conditions, a large MUSTARD POULTICE is applied to the legs.

A MUSTARD BATH, in the strength of 1 dram (4.0 Gm.) to 1 gallon (3785.43 Cc.) of water, is an efficient means of breaking up a *cold*, and if properly used is of service when the rash in *measles* or *scarlet fever* has receded.

The *menses* may often be re-established when suppressed by a MUSTARD SITZ-BATH, taken at the time of the expected period.

Internally.—Other than the use of mustard as a condiment, the drug is given only to produce vomiting, being one of the best emetics in *indigestion* and *narcotic poisoning*.

Obstinate *hiccough* has sometimes been arrested by an INFUSION OF MUSTARD.

Administration.—A mustard plaster, or sinapism, is prepared by mixing equal parts of wheaten or rye flour with water to the consistence of a thick paste, which is spread on linen or cotton cloth and applied to the skin. A dampened piece of gauze interposed between the plaster and the skin will prevent the former from adhering.

A mustard cataplasm is a weaker preparation. A flaxseed or cornmeal poultice is made, to which a small quantity of ground mustard is added. This is intended to maintain a gentler but more prolonged action than the *sinapism*.

"Mustard leaves," or plasters which may be obtained ready prepared at drug stores, are intended to be simply dipped in water and applied to the skin. Their activity may be lessened by interposing a thin piece of linen or cotton cloth between the plaster and the skin.

Liniments containing oil of mustard are efficient rubefacients, care being taken to adapt the strength of the preparation to the delicacy of the skin.

When mustard is taken as an emetic it is given in the form of an infusion, in the proportion of 1, 2, or 3 drams (4.0, 8.0, or 12.0 Gm.) to 1 pint (473.17 Cc.) of water.

A preparation known as *mustard whey* is sometimes given. It is prepared by boiling 1½ ounces (46.65 Gm.) of bruised mustard seed in a mixture of 1 pint (473.17 Cc.) of milk and 1 quart (946.35 Cc.) of water, until it is curdled, when the whey should be strained off.

Allied Products.

Thiosinamine, a product from the volatile oil of mustard, is a useful drug for keloid and scar tissue. It is used in 10–20 per cent. strength as an injection or local application.

Ōleum Terebĭnthinæ—Ōlei Terebĭnthinæ—Oil of Turpentine. *U. S. P.*

Origin.—A volatile oil recently distilled from turpentine—a concrete oleoresin obtained from *Pinus palustris* Miller and other species of *Pinus*.

Description and Properties.—A thin, colorless liquid, of a characteristic odor and taste, both of which become stronger and less agreeable with age and exposure to air. Soluble in three times its volume of alcohol. Oil of turpentine should be kept in well-stoppered bottles, protected from light.

Dose.—5–15 minims (0.3–1.0 Cc.), in emulsion.

Official Preparations.

Emŭlsum Ōlei Terebĭnthinæ—Emŭlsi Ōlei Terebĭnthinæ—Emulsion of Oil of Turpentine.—*Definition.*—A 15 per cent. (by volume) emulsion of rectified oil of turpentine, containing 5 per cent. (by volume) of expressed oil of almond. *Dose.*—Average dose: 1 fluidram (4 Cc.), U. S. P. One fluidram contains about 9 minims of oil of turpentine.

Linimĕntum Terebĭnthinæ—Linimĕnti Terebĭnthinæ—Turpentine Liniment (35 per cent. with resin cerate). For external use.

Ōleum Terebĭnthinæ Rectificātum—Ōlei Terebĭnthinæ Rectificāti—Rectified Oil of Turpentine.—*Dose*, 5–15 minims (0.3–1.0 Cc.) [15 minims (1 Cc.), U. S. P.].

Physiological Action.—*Externally and Locally.*—When applied to the epidermis the drug dilates the cutaneous blood-vessels, occasioning a sensation of heat and producing redness of the skin, and, if the oil be applied with inunction for any length of time, vesication ensues, with, occasionally, intractable ulcerations. The fumes

of oil of turpentine when inhaled cause great irritation of the eyes and the respiratory passages.

The drug is readily absorbed from the unbroken skin.

Internally.—Digestive System.—When taken into the mouth turpentine produces a burning, pungent taste and an immediate and augmented salivary secretion. Swallowed in immoderate amounts, the drug occasions a sensation of heat in the epigastrium, with increased peristaltic action and secretion. The intestines are similarly affected, the intestinal peristalsis being greatly augmented, the drug acting as an efficient carminative.

Large doses of turpentine produce severe burning pain in the stomach and bowels, accompanied by nausea, vomiting, and purging, the feces often containing blood.

The drug is an efficient anthelmintic for tapeworm.

Circulatory System.—Turpentine is a cardiac stimulant, increasing the force and rapidity of the heart's action and raising arterial tension by direct cardiac influence. The blood-vessels are contracted by the drug, which may account for its hemostatic properties. Very large doses slow the heart by stimulating the vegus inhibitory center.

Nervous System.—Small doses increase and large doses diminish reflex excitability. Large doses produce giddiness, mental exhilaration, and incoherence of ideas, followed by dulness and occasional coma.

There is incoördination of movements, resulting in unsteady gait, great muscular weakness, and diminished sensation, usually preceding the impairment of voluntary motion.

Respiratory System.—The effect of inhaled oil of turpentine on the respiratory passages has been described. When ingested the drug increases and disinfects the bronchial secretion. Small doses increase and large doses diminish the respiratory movements.

Absorption and Elimination.—Oil of turpentine is rapidly diffused in the blood, in moderate doses stimulating the kidneys and increasing the flow of urine, to which it imparts the odor of violets. Large doses irritate the kidneys, lessening the amount of urine, rendering it highly colored, and in some cases producing albuminuria, hematuria, and even total suppression. There are present priapism and a frequent desire to micturate.

Turpentine is rapidly eliminated from the system, not only by the kidneys, but by the skin, and bronchial and intestinal mucous membranes as well.

Temperature.—The drug is a mild antipyretic.

Untoward Action.—Erythema and eczematous eruptions are produced by both the ingestion and the local application of turpentine. In susceptible individuals small doses may occasion serious disturbances of the genito-urinary and gastro-intestinal tracts, such as strangury, painful erections, salivation, and stomatitis.

The administration of repeated doses of oil of turpentine may

produce peculiar nervous manifestations, such as headache, drowsiness, dizziness, and a sense of mental vacuity.

Poisoning.—Few cases are recorded of death resulting from the ingestion of excessive amounts of turpentine, owing to the fact that the greater amount of the drug is eliminated by the intestines.

The symptoms produced by very large doses are—great muscular weakness, abolition of reflexes, and violent vomiting and purging, with bloody evacuations from the bowels. There is great irritation of the genito-urinary tract, with constant efforts to micturate, hematuria or entire suppression of urine, painful priapism, and violent strangury.

The skin is moist and the face flushed or cyanosed, while dilatation of the pupils, slow, labored and stertorous breathing, and occasionally paroxysms of convulsive coughing, may be attendant symptoms. Convulsions may occur. Icterus has been noted.

Either great mental excitement or profound insensibility may be present. The heart and circulatory system are greatly depressed, death, when occurring, being usually the result of cardiac failure. 15 Gm. has been deadly for a child, and 120 Gm. has been taken by an adult without a fatal result.

A form of chronic poisoning frequently is seen among those who work with turpentine, such as painters, etc.; sleepiness, heaviness, easily tired, and great muscular heaviness are frequent symptoms. Insomnia, irritable heart action, acne, and general malaise are other common symptoms.

Treatment of Acute Poisoning.—The stomach should be at once evacuated, and elimination favored by every possible means. The free administration of demulcent drinks is advisable, while to relieve pain, opium may be given. Other symptoms should be treated according to their indications.

Therapeutics.—*Externally and Locally.*—OIL OF TURPENTINE is an efficient counterirritant, being employed as such in *lumbago*, *myalgia*, *neuralgia*, *rheumatic pains*, *bronchitis*, *pleurisy*, and various forms of *chronic inflammation*. A TURPENTINE STUPE is perhaps the most effective method in the local application of the drug. It is applied as follows: (1) A flannel is wrung out of hot water, sprinkled well with the oil, and allowed to remain in contact with the affected part for from five to twenty minutes, as indicated by the sensibility of the skin. Care must be taken in the preparation of the flannel lest the patient be chilled or scalded. (2) A vessel containing the oil is placed in hot water and a flannel wrung from the oil applied as desired.

A TURPENTINE STUPE is perhaps the most grateful and efficient local application in *peritonitis*.

Owing to its antiseptic and hemostatic properties the OIL OF TURPENTINE is frequently and beneficially employed as a dressing for *lacerated wounds*.

The drug is an active parasiticide, and has been used success-

fully in the treatment of *tinea tonsurans*, etc. It has also been favorably recommended, when diluted with some bland oil, as a remedy for *alopecia areata* and *psoriasis*.

TURPENTINE serves a useful purpose in many diseases of the *ear* and *throat*.

J. Solis Cohen recommends the VAPOR OF TURPENTINE as an efficient means of allaying the *cough* and *irritation* occasioned by *acute laryngeal catarrh*.

The inhalation of the OIL OF TURPENTINE lessens *pulmonary hyperemia* and *excessive bronchial secretion*.

Internally.—TURPENTINE is a valuable remedy for *gastric* or *intestinal flatulence*, particularly when the condition arises from an atonic state of the muscles of the stomach or intestines.

The drug is frequently employed in *typhoid fever*, not only for the relief of *tympanitis*, but also to check *intestinal hemorrhage*.

In *chronic intestinal catarrh*, as well as in a catarrhal condition of any mucous membrane, turpentine is a valuable remedial agent.

TURPENTINE is a very powerful anthelmintic against tapeworm. When given for this purpose it should be administered in a single large dose, from 4–8 fluidrams (15.0–30.0 Cc.), together with a large dose of some purgative like castor oil to ensure the prompt elimination of the turpentine from the bowels.

As has been suggested, the drug has a decided and beneficial influence upon relaxed and chronic catarrhal conditions of mucous membranes, rendering this remedy of great value in *bronchorrhea*, *chronic bronchitis*, *emphysema* with marked bronchial catarrh, etc. This action upon the mucous membranes, together with the diuretic properties of the drug, renders turpentine an exceedingly valuable remedy in the treatment of *gleet*, *subacute gonorrhea*, *chronic cystitis*, *spermatorrhea*, *prostatorrhea*, *pyonephrosis*, etc.

Contraindications.—Oil of turpentine should never be given to patients suffering from Bright's disease or acute inflammation of the gastro-intestinal or genito-urinary tracts.

Administration.—Small doses of turpentine may be given on lumps of cut sugar, but usually preference is given to administration in the form of a capsule or an emulsion, 1 fluidram (4.0 Cc.) of mucilage of acacia, if properly manipulated, emulsifying ½ fluidram (2.0 Cc.) of oil of turpentine with 1 fluidounce (30.0 Cc.) of water. Flavoring substances can be incorporated in the emulsion, rendering the preparation not unpleasant to the taste.

In giving turpentine its tendency to produce untoward manifestations, particularly of the genito-urinary tract, should be remembered, care being invariably exercised in the administration of the drug.

For external use the drug may be used in full strength, diluted with some bland oil or ointment, or applied in the form of stupes.

Turpentine is sometimes employed as an enema, in which case it should, of course, be mixed with some bland oil and mucilage of acacia in the form of an emulsion.

Rhŭs Toxicodĕndron—Rhōis Toxicodĕndri—Rhus Toxicodendri. (*Non-official.*)

(Poison Ivy.)

Origin.—The fresh leaves of *Rhus radicans* L., a climbing shrub indigenous in Canada and the greater part of the United States westward to the Rocky Mountains.

Description and Properties.—Long-petiolate, trifoliate, the lateral leaflets sessile or nearly so, about 4 inches (10 Cm.) long, obliquely ovate, pointed; the terminal leaflets stalked, ovate or oval, pointed, with a wedge-shaped or rounded base; the leaflets entire and glabrous or variously notched, coarsely toothed or lobed, more or less downy; when dry, papery and brittle; inodorous; taste somewhat astringent and acrid. The fresh leaves abound in an acrid juice which darkens on exposure to air, and when applied to the skin produces inflammation and swelling. The leaves should therefore not be touched with the bare hands.

The fresh leaves contain a volatile principle termed toxicodendrol by Pfaff. In addition to this active constituent the leaves contain tannin.

Dose.—1–5 grains (0.06–0.3 Gm.).

Physiological Action.—*Externally and Locally.*—The fresh leaves of this common plant are extremely irritant to the skin, generally acting as a marked vesicant and establishing severe local inflammation, manifested by acute dermatitis, excessive edema, and hyperemia. In many cases these effects are much less pronounced, while in certain individuals they are never occasioned by contact with or even chewing the leaves. As with poison sumach—*Rhus venenata*—the toxic influence of the plant derived from local application is apparently more virulent during the period of flowering.

The inflammation somewhat resembles erysipelas, being rapidly diffused and accompanied by a general systemic disturbance, including abdominal pains, nausea, and vomiting, with perhaps diarrhea, diuresis, and serous passages. Profuse diaphoresis and lumbar and articular pains may also result. These symptoms cease after about ten days or a fortnight without other sequel than desquamation of the affected surface.

Internally.—The effects of the drug administered internally are to cause gastro-intestinal inflammation, with drowsiness and stupor, and occasionally delirium and convulsions. Vertigo, nausea, chilliness, thirst, weak and irregular cardiac movements, diaphoresis, muscular debility, and diuresis are also reported.

Treatment of Poisoning.—Many remedies have been used, with varying efficacy, to allay the toxic effect of the drug. Dermal poisoning has been relieved by glycerite of carbolic acid or alkaline lotions. In the earlier stage of external irritation warm soapsuds and sodium bicarbonate have been successfully applied. Alum-curd, ammonia in a weak solution, solution of chlorinated soda, and many other agents have been employed to meet the requirements of certain stages of the affection. Orthoform or anesthesin in an ointment base, as oxide of zinc, is a useful analgesic.

Therapeutics.—*Externally and Locally.*—The diluted tincture —8 minims (0.5 Cc.) to 4 ounces (118 Cc.) of water—has met with some favor in the treatment of sprains, burns, etc.

In weak solution with alcohol the remedy has been used as a

stimulating application in cases of *sprains*, *chilblains*, *burns*, *insect-stings*, etc.

Internally.—It has been recommended in so many affections that it is highly doubtful if it is valuable for any.

The drug is in need of much more thorough investigation, there being widely diverse opinions regarding its therapeutic value. There is, however, sufficient testimony in its favor from competent authorities to justify further examination and use of this extremely active remedy.

Contraindications.—The meager knowledge we possess respecting its true action in disease renders it impossible to mention any special contraindication to its employment.

Administration.—The tincture is the only preparation used, and should be cautiously administered.

CAUSTICS OR ESCHAROTICS.

Caustics are medicines which destroy the tissues to which they are applied. They excite inflammation and vascular dilatation of the surrounding area. The eschar produced by these drugs is separated from the living tissues by the inflammation and suppuration produced.

The action of caustics is typically a chemical or physicochemical one. The layer of cells that may be destroyed varies in depth with the caustic employed, and the caustic used may cause a hard, smear-like, or fluid eschar, which, by demarcating inflammatory processes, is sooner or later thrown off. The caustics may be divided roughly into caustic acids, caustic alkalies, caustic metallic salts, and some few organic caustic compounds not readily classified. In many of the acids and salts the action of the acid ion of the caustic causes oxidation and reducing processes. By many of the acids an acid albumin or syntonin is formed; by the alkalies, an alkali albuminate; and by the salts, metal albuminates are produced. Many of these metal albuminates are permanent, in which case a characteristic hard and scaly eschar results.

The character of the eschar is determined largely by the tissue involved: thus, by alkaline caustics, the keratin of the skin is dissolved; fatty substances are converted into soaps or soapy masses. Many caustics have the power of being absorbed and of causing systemic poisoning. The salts of chromium, osmium, and arsenic are of importance in this connection.

Many of the caustics cause extreme pain, and their use is gradually being abandoned for the more accurate methods of surgery.

Caustics are employed for the following general purposes:

1. In specific acute poisonous injuries, as from the bite of poisonous insects, reptiles, or other animals. The caustic is applied to the wound directly, in order to destroy the poison.

Permanganate of potash, alkalies, or the direct cautery are the most reliable.

2. To destroy new growths of microbial origin. In lupus, sarcoma, carcinoma, chancres, charbon, etc., nitric acid, alkalies, glacial acetic acid, etc. are most employed.

3. To remove small tumors, warts, polypi (nasal or genital), hypertrophied mucous membranes. Here nitric and chromic acids, silver nitrate, etc., are of service.

4. For depilatory purposes—removing hair, etc.

5. To reduce and destroy inoperable tumors. Here the more caustic alkalies, arsenic, zinc, etc., have been widely employed in the past.

6. To reduce flabby and exuberant granulations in wounds. Nitrate of silver is one of the best drugs.

7. At times to influence deeper parts, in neuralgias and inflammatory action in an internal organ, it is beneficial to employ a superficial escharotic.

Those escharotics which have not been discussed elsewhere will here be considered in detail:

Chrŏmii Triŏxidum—Chrŏmii Triŏxidi—Chromic Trioxide. *U. S. P.*

(CHROMIC ANHYDRIDE; CHROMIC ACID. U. S. P.)

Origin.—Dissolve potassium bichromate in sulphuric acid and water; decant; heat with more sulphuric acid; cool, and crystallize.

Description and Properties.—Small, needle-shaped crystals or rhombic prisms, of a dark purplish-red color and metallic luster; odorless; destructive of animal and vegetable tissues; deliquescent in moist air. Very soluble in water, forming an orange-red solution. When brought in contact with alcohol, ether, glycerin, and other organic solvents decomposition takes place, sometimes with dangerous violence. Chromium trioxide should be kept in glass-stoppered bottles, and great caution should be observed to avoid bringing it in contact with organic substances, such as cork, tannic acid, sugar, alcohol, etc., as dangerous accidents are liable to result. Used externally.

Physiological Action and Therapeutics.—Chromium trioxide is a powerful caustic, deodorant, and disinfectant. It coagulates albumin and oxidizes organic matter. Its action is slow, and the pain following its application is usually of shorter duration than that of most caustics. Weak solutions are stimulant, astringent, and alterative.

Chromic acid is used in the form of a paste or in solutions of various strengths for the removal of *syphilitic warts*, *vegetations*, *condylomata*, etc. As a caustic and stimulant application in many diseases of ear, nose, and throat it serves a valuable purpose, as in *nasal polypi*, *enlarged tonsils*, *chronic and syphilitic laryngitis*, *laryngeal papillomata*, *chronic superficial glossitis*, *tuberculosis of the tongue*, *ozena*, *ulcerations of the mouth*, etc.

A 10 per cent. solution of chromic acid has been found serviceable in the treatment of *hyperidrosis*.

A solution of 1 part of chromic acid in 40 parts of water makes an efficient lotion for disinfecting *foul ulcers* and as an injection in *gonorrhea*, *leucorrhea*, etc.

Sessile piles and *salivary fistulæ* are efficiently treated by touching the parts with pure chromic acid.

Potăssii Hydrŏxidum—Potăssii Hydrŏxidi—Potassium Hydroxide. *U. S. P.*

(Potassium Hydroxide; Caustic Potash; Potassa. U. S. P., 1890.)

Origin.—Prepared by evaporating liquor potassæ, fusing the residue, and pouring into clean cylindrical molds which have been previously warmed.

Description and Properties.—Dry, white, translucent pencils, or fused masses, hard and brittle, showing a crystalline fracture; odorless or having a faint odor of lye, and of a very acrid and caustic taste. Because of its active effect upon organic tissues it should be tasted and handled with exceeding care. Exposed to the air, it rapidly absorbs carbon dioxide and moisture, and deliquesces. Soluble in about 0.4 part of water and in 2 parts of alcohol. Potassa should be kept in well-stoppered bottles made of hard glass. Used externally.

Sōdii Hydrŏxidum—Sōdii Hydrŏxidi—Sodium Hydroxide. *U. S. P.*

(Caustic Soda; Soda. U. S. P., 1890.)

Origin.—Prepared from a solution of soda in the same manner as described under Potassii Hydroxidum.

Description and Properties.—Dry, white, translucent pencils or fused masses, showing a crystalline fracture, odorless, and having an acrid and caustic taste. Great caution is necessary in tasting and handling it, as it rapidly destroys organic tissues. Exposed to the air, it rapidly deliquesces, absorbs carbon dioxide, and becomes covered with a dry coating of carbonate. Soluble in 1 part of water, very soluble in alcohol. Soda should be kept in well-stoppered bottles made of hard glass. Used externally.

Physiological Action and Therapeutics.—Potassii hydroxidum is one of the strongest and most penetrating caustics known. It possesses the property of abstracting water from the tissues, neutralizing free acids, decomposing nitrogenous compounds, and of forming solutions of fibrin, albumin, and gelatin.

When applied to the soft tissues it occasions severe pain, and produces a moist, ashen, and then black, leathery slough, which leaves a granulating ulcer behind it.

When potassium hydroxide is taken internally in immoderate doses it produces all the symptoms of corrosive poisoning. Small doses, freely diluted, have the same action as the alkalies.

As a caustic, potassa is used for the same purposes as the caustics previously described.

The action and therapeutics of sodium hydroxide are identical with those of potassa, save that soda is less depressing to the heart, muscular and nervous systems. It is not used so much as potassa, the latter preparation usually being preferred as a caustic.

To limit the caustic action of these drugs a piece of adhesive plaster should be applied first, with an aperture of the size desired.

Upon the skin exposed in the hole in the plaster the caustic is placed, the skin having been previously moistened. The caustic action may be arrested at any time by wetting the part with vinegar.

Ăcidum Acēticum Glaciāle—Ăcidi Acētici Glaciālis—Glacial Acetic Acid. *U. S. P.*

Origin.—Prepared by distilling dry sodium acetate with strong sulphuric acid.

Description and Properties.—A clear, colorless liquid, of a strong, vinegar-like odor, and a very pungent, purely acid taste. Its specific gravity at 25° Cc. (77 F.) should not be higher than 1.049, corresponding to at least 99 per cent. of absolute acid.

Used externally.

Physiological Action and Therapeutics.—Glacial acetic acid is a powerful corrosive poison, having an action similar to that of the mineral acids. The drug is principally used as a caustic for the removal of *warts* and *corns*, and occasionally for *blistering the skin.*

Ăcidum Trichloracēticum—Ăcidi Trichloracētici—Trichloracetic Acid. *U. S. P.*

Definition.—A monobasic organic acid, $CCl_3.COOH$, usually obtained by the oxidation of hydrated chloral with nitric acid.

Description and Properties.—White, deliquescent, rhombohedral crystals, having a slight, characteristic, mildly pungent odor. Very soluble in water and alcohol; in the latter, part of the acid is changed into the ester. The aqueous solution on boiling is decomposed with the formation of chloroform and carbon dioxide: $CCl_3COOH = CHCl_3 + CO_2$.

10 parts of trichloracetic acid and 1 part of water form a liquid known as acidum trichloraceticum liquefactum; it is often dispensed in this form. (See *Phenol Liquefactum*).

It precipitates proteids and is used as a reagent for the detection of albumin in urine and milk.

Trichloracetic acid is far stronger than acetic acid and should be used with great caution.

Călx—Călcis—Lime. *U. S. P.*

Origin.—Obtained by burning white marble, oyster shells, or the purest varieties of natural calcium carbonate.

Description and Properties.—Hard, white or grayish-white masses, which, in contact with air, gradually attract moisture and carbon dioxide, and fall to a white powder; odorless; of a sharp, caustic taste. Soluble in about 760 parts of water, insoluble in alcohol.

Used externally.

Physiological Action and Therapeutics.—Quicklime when used undiluted is caustic, producing effects similar to those described under *Potassa.*

For caustic purposes it is usually mixed with potassa (potassa cum calce). When lime is given in diluted solution it acts as an astringent and antacid. (See *Liquor Calcis.*)

The conditions for which lime is employed as a caustic are mentioned under *Potassa.*

Zīnci Chlōridum—Zīnci Chlōridi—Zinc Chloride. *U. S. P.*

Origin.—Prepared by dissolving zinc in boiling hydrochloric acid. To the solution is added first nitric acid, then zinc carbonate to precipitate the impurities. Filter and finally evaporate.

Description and Properties.—A white, granular powder or porcelain-like masses, irregular or molded into pencils; odorless; of such intensely caustic properties as to make tasting dangerous, unless the salt is dissolved in much water, when it has an astringent, metallic taste. Very deliquescent; soluble in about 0.4 part of water, forming a clear solution; very soluble in alcohol. Zinc chloride should be kept in small, glass-stoppered bottles.

Used externally.

Official Preparation.

Liquor Zīnci Chlōridi—Liquōris Zīnci Chlōridi—Solution of Zinc Chloride (U. S. P.).—Used externally.

Physiological Action and Therapeutics.—ZINC CHLORIDE is caustic, antiseptic, disinfectant, irritant, astringent, and slightly hemostatic, according to the strength of the preparation. Its caustic action is painful, yet, while the drug penetrates very deeply, limited to the seat of application.

Poisoning by zinc chloride is evidenced by all the symptoms produced by a violent corrosive irritant poison.

The drug formerly enjoyed quite a reputation as a remedy for *cancer*, especially *epithelioma*, in which case it was used in the form of "caustic arrows" inserted in the base of the growth so as to separate it from the healthy tissues.

It is used as a paste and lotion for *morbid growths*, *lupus exedens*, *putrid ulcers*, *nævi*, and *syphilitic sores*.

SOLUTIONS OF ZINC CHLORIDE are injected into *polypi* and *scrofulous glands*, and for the destruction of the *pulp of decayed teeth*.

A weak solution of zinc chloride is an efficient injection in *gonorrhea*, *leucorrhea*, and *hemorrhagic endometritis*.

For caustic purposes the ZINC CHLORIDE itself may be used, or a paste prepared with starch, gypsum, flour, anhydrous sulphate of lime, or powdered althea. MAYET'S PASTE consists of zinc chloride 8 parts, zinc oxide 1 part, dried wheat flour 7 parts, and water 1 part. The cuticle must always be removed before applying the paste, strong water of ammonia answering for this purpose.

Brōmum—Brōmi—Bromine. *U. S. P.*

Origin.—It is found both in seawater and in saline springs, but is chiefly obtained from the mother-liquors of salt-works in the United States and at Strassfurth, Germany.

Description and Properties.—A heavy, dark brownish-red, mobile liquid, evolving, even at ordinary temperatures, a yellowish-red vapor, highly irritating to the eyes and lungs, and having a peculiar suffocating odor, resembling that of chlorine. Soluble in 28 parts of water and readily soluble in alcohol or ether. Bromine should be kept in glass-stoppered bottles, in a cool place.

Used externally.

Physiological Action and Therapeutics.—BROMINE is a powerful corrosive irritant, the fumes of which occasion severe irritation of the eyes and respiratory passages, with cough, hoarseness, and dyspnea. When taken into the stomach it produces all the symptoms of corrosive poisoning.

The drug is an active caustic, deodorant, and disinfectant. It was formerly extensively employed, particularly during the Civil War of the United States, for the treatment of *hospital gangrene*, for which it is a most efficient remedy. Bromine has also been used as an injection (1 part to 3 of alcohol) in various forms of *cancer*. Owing to the pain attending the operation, however, the treatment has not been generally adopted.

Bromine is an efficient disinfectant, and has been employed to disinfect and deodorize the atmosphere of hospitals, etc. Berlin sanitary officials declare that "3½ ounces of bromine can disinfect a space of 918 cubic feet, and deodorize a space of 7000 cubic feet."

EMOLLIENTS, DEMULCENTS, AND PROTECTIVE AGENTS.

EMOLLIENTS are substances which soften, relax, and protect the tissues to which they are applied. They relieve pain and tension by diminishing heat and lessening the pressure on the nerves.

Emollients and demulcents are largely interchangeable terms. The former are applied to the skin; the latter, to mucous membranes.

The principal emollients are:

Glycerin,
Soap liniment,
Starch,
Fats and oils, ... { Lard, Olive oil, Almond oil, Spermaceti, Linseed oil, Cacao butter, Petroleum, Paraffin, Petrolatum, Vaseline, etc.
Hot fomentations,
Poultices, ... { Linseed meal, Oatmeal, Bran, Bread, Flour, Figs, etc.

DEMULCENTS are substances which soothe and protect the parts

to which they are applied. They are generally of a mucilaginous nature, and are employed for their action upon mucous membranes, while emollients are principally used on the skin.

The important demulcents are:

Acacia,	Marshmallow,	Sassafras-pith,
Barley,	Licorice,	Isinglass,
Cetraria,	Starch,	Honey,
Almond,	Tragacanth,	Gelatin,
Flaxseed,	Glycerin,	Bland oils.
Slippery elm,	White of egg,	

Both emollients and demulcents are exceedingly useful agents to relieve irritation of the skin in certain cutaneous diseases; by softening the skin and mucous membranes they also prevent cracking or chapping from exposure to cold. They are also efficient agents to prevent *bedsores* and to lessen friction between approximating surfaces, as between the nates and about the groins of children.

Demulcents are employed internally with good results when there is an *irritated or inflamed condition of mucous membranes*, whether of the respiratory, gastro-intestinal or genito-urinary tracts, as in *bronchitis*, *gastritis*, *enteritis*, *diarrhea*, *dysentery*, *strangury*, *cystitis*, etc.

Demulcents—such as FLAXSEED, SLIPPERY ELM, MARSHMALLOW, or SASSAFRAS-PITH—are very agreeable and efficient agents to *quench thirst* and to relieve the irritation of mucous surfaces in *febrile affections*.

PROTECTIVES are agents used to mechanically cover and protect injured or diseased surfaces from extraneous influences, as from air, water, etc.

Certain agents classed as protectives are employed for their absorptive power of taking up by capillary attraction any moisture or fluid present.

They are useful agents as protective coatings to *bedsores* or to *excoriated*, *abraded*, or *burned surfaces*.

The principal protectives are:

Collodion,
Solution of gutta-percha,
Solution of sodium silicate,
Court-plaster (emplastrum ichthyocollæ),
Lycopodium,
Charcoal,
Animal charcoal,
Purified cotton.

The emollients, demulcents, and protectives which are deemed sufficiently important to merit more consideration than has been given them elsewhere in the present work, will be here considered.

Glycerīnum—Glycerīni—Glycerin. *U. S. P.*

Origin.—A liquid obtained by the decomposition of vegetable or animal fats or fixed oils, and containing not less than 95 per cent. of absolute glycerin.

Description and Properties.—A clear, colorless liquid, of a thick, syrupy consistence, oily to the touch, odorless, very sweet and slightly warm to the taste. When exposed to the air it slowly abstracts moisture. Specific gravity not less than 1.246. Soluble in all proportions in water or alcohol; also soluble in a mixture of 3 parts of alcohol and 1 part of ether, but insoluble in ether, chloroform, carbon disulphide, benzin, benzol, and fixed or volatile oils.

Dose.—5–60 minims (0.3–4.0 Cc.) [1 fluidram (4 Cc.), U. S. P.].

Official Preparations.

Glycerītum Ămyli—Glycerīti Ămyli—Glycerite of Starch.—Starch, 10; water, 10; glycerin, 80.

Used internally or externally.

Suppositōria Glycerīni—Suppositōria (acc.) **Glycerīni—Suppositories of Glycerin.**—Each suppository contains 93 grains (6.0 Gm.) of glycerin.

Used as required.

Gelatīnum Glycerinātum—Gelatīni Glycerināti—Glycerinated Gelatin.—A mixture of equal parts of gelatin and glycerin. The mass when cold is solid, but easily melts on applying gentle heat.

Basis for suppositories and bougies.

Of late years both ointments and cerates have been largely superseded, especially in Europe, by dertamologic pastes and glycerogelatins. The former are mixtures of the medicinal agents with starch, dextrin, or kaolin, and glycerin, soft soap, petrolatum, or lard, and are intended chiefly for antiseptic, astringent, or germicidal effects. The glycero-gelatins are firmer than the pastes, and must be melted before they can be applied (Hunt).

Glycerin is also contained in the following official preparations:

Glycerītum Phenōlis, Glycerītum Ăcidi Tănnici, Glycerītum Boroglycerīni, Glycerītum Hydrăstis, Mucilāgo Trăgacanthæ, Măssa Hydrărgyri, Pĭlulæ Phŏsphori, and in many extracts and fluidextracts.

Antagonists and Incompatibles.—Glycerin is incompatible with potassium permanganate and with chromic acid.

Synergists.—Its emollient properties may be enhanced by other emollients and demulcents.

Physiological Action.—*Externally and Locally.*—When glycerin is applied to the skin or mucous membrane it is ordinarily bland and unirritating, although in certain cases the drug occasions a sensation of burning and smarting, which may be due either to an impure preparation, the rapid absorption of water from the tissues, or merely to a marked idiosyncrasy on the part of the patient. Should the pure drug show a tendency to irritate the skin, the glycerin should be properly diluted with water.

Preparations more concentrated than the specific gravity recommended by the U. S. Pharmacopœia—viz. 1.246—should be avoided, because of their irritating properties.

Glycerin abstracts water from the tissues, and is rapidly absorbed through the skin. It possesses marked diffusive power, being capable of diffusing itself freely over and through organic matter.

Internally.—The principal action of glycerin when taken inter-

nally is that of a purgative. The drug purges when given by the rectum, either as an enema or in the form of a suppository.

Glycerin is readily absorbed from the alimentary canal, and it is thought to undergo oxidation, thereby acting as a food and increasing body-weight. Some competent investigators allege that it is not in the least degree nutritious.

When immoderate amounts of the drug are taken, it may be detected in the urine, while under excessive doses effects may be produced similar to those resulting from alcoholic poisoning.

Following the ingestion of very large doses, there may be extreme muscular weakness, dryness of mucous membranes, dark-colored urine, collapse, and death. The drug is not considered poisonous, excessive amounts being necessary to produce the symptoms above described.

Therapeutics.—*Externally and Locally.*—GLYCERIN is a popular and efficient remedy for *chapped hands* and slight *excoriations*.

Fissured nipples and *fissure of the anus* are well treated with pure GLYCERIN or with glycerin and tannic acid. The drug also makes an efficient application to *bedsores*.

GLYCERIN is employed as an injection in *gonorrhea*. It may be used alone or medicated with bismuth subnitrate or with extract of opium.

GLYCERIN is one of the best solvents for hardened *cerumen*, and tampons wet with glycerin or with GLYCERITE OF TANNIC ACID are very serviceable in *leucorrhea* and *erosion of the cervix*, and *endometritis* with *congestion and subinvolution of the uterus*.

GLYCERIN possesses marked antipruritic properties, and, whether applied pure or combined with oils or ointments, will allay *itching* of most affections of the skin.

LOTIONS OR DILUTED AQUEOUS SOLUTIONS OF GLYCERIN are frequently employed in various diseases of the *ear*, *nose*, and *throat*, such as *fissure of the tongue*, *chronic laryngitis*, *chronic nasal catarrh*, *coryza*, *pharyngitis*, etc.

A mixture of GLYCERIN AND WATER will lessen or prevent *dryness of the mouth* from fever or other causes.

GLYCERIN is an efficient topical remedy for the reduction of *edema of the prepuce*, and is a serviceable antiseptic dressing for *wounds*, *carbuncles*, *boils*, etc.

GLYCERITE OF STARCH is an excellent soothing emollient in *acute eczema*, and quite an efficient preparation to prevent pitting in *variola*.

Internally.—The principal internal use for GLYCERIN is for the relief of *habitual constipation*, being far more efficient in habitual, than in occasional, constipation, and more generally applicable to females than to males, and to those cases where the fecal mass is retained in the rectum than in the sigmoid flexure or above it. For the purpose of relieving constipation it may be given by the mouth, alone or associated with castor oil, or 1 or 2 fluidrachms (4.0–8.0 Cc.) injected into the rectum, or, which perhaps is the

most agreeable method, by the insertion into the rectum of a GLYCERIN SUPPOSITORY.

Administration.—Whether glycerin be used externally or internally, it should always be chemically pure, otherwise much irritation may be produced.

For external use it may be used pure or mixed with water, or in various lotions, ointments, etc.

Internally it is seldom given alone, but with syrups, water, wine, or other alcoholic liquors.

Ădeps Lănæ—Ădipis Lănæ—Wool-fat. *U. S. P.*

Definition.—The purified fat of the wool of sheep, freed from water. The hydrous wool-fat, which contains "not more than 30 per cent. of water," is still retained in the Pharmacopœia; if this be heated on the water-bath, with stirring, until it ceases to lose weight, it is converted into adeps lanæ.

In making certain ointments, the water contained in hydrous wool-fat is objectionable; for such preparations adeps lanæ is preferable.

Petrolātum Ălbum—Petrolāti Ălbi—White Petrolatum. *U. S. P.*

"A white, unctuous mass of about the consistency of an ointment." It is purified petrolatum and is used in the preparation of the ointment of boric acid, the ointment of phenol (Unguentum Acidi Carbolici, U. S. P., 1890), etc.

Ōleum Olīvæ—Ōlei Olīvæ—Olive Oil. *U. S. P.*

Origin.—The fixed oil expressed from the fruit of *Olea europæa* L., a shrubby, thorny, medium-sized tree, indigenous in Western Asia, but cultivated in the countries bordering on the Mediterranean and in the Southern United States, California, and several South American and other countries.

Description and Properties.—A pale-yellow or light greenish-yellow, oily liquid, having a slight, peculiar odor, and a nutty, oleaginous taste, with a faintly acrid after-taste. Very sparingly soluble in alcohol, but readily soluble in ether, chloroform, or carbon disulphide. Olive oil should be kept in well-stoppered bottles, in a cool place.

Dose.—Freely.

Physiological Action and Therapeutics.—OLIVE OIL is a singularly bland and agreeable oil, and very useful as an emollient and demulcent. It serves as an efficient protective to the skin, from which it is readily absorbed. As a lenitive and protective in cases of superficial *wounds*, *bruises*, *excoriations*, *burns*, *bites* and *stings of insects*, *sprains*, etc., it serves a valuable purpose.

It is extensively employed by dermatologists to soften and facilitate the removal of *crusts*, *scales*, and *epithelial débris* of various *cutaneous disorders*.

The application of warm olive oil, made with gentle friction, to *painful* and *engorged mammary glands* during pregnancy and after parturition generally lessens the pain and swelling.

The drug is an efficient palliative in *painful deglutition*, and is sometimes injected into the rectum as a soothing emollient in *dys-*

entery, and to destroy "*seatworms*" and allay the irritation produced by them.

Frequently the forcible injection into the urethra of olive oil will dilate an unusually tight *stricture*, partly overcoming the difficulty to the introduction of a sound.

Olive oil is habitually employed as a lubricant for sounds, catheters, specula, pessaries, etc.

Where a fat or an oil is not contraindicated, olive oil is one of the most efficient demulcents to administer in cases of *poisoning from corrosive irritating drugs*.

Olive oil is a useful and pleasant laxative, and is used to a considerable extent for that purpose. The oil is also credited with facilitating the discharge of *gall-stones*. It unquestionably increases the secretion of bile, which may account for its apparent influence in favoring the expulsion of these concretions.

Ōleum Amy̆gdalæ Exprĕssum—Ōlei Amy̆gdalæ Exprĕssi—Expressed Oil of Almond. *U. S. P.*

Origin.—A fixed oil expressed from bitter or sweet almond (*Prunus Amygdalus*, var. *amāra* and *dulcis*, De Candolle), a tree 15 to 20 feet (5 to 6 M.) high, indigenous in Western Asia and cultivated in subtropical countries.

Description and Properties.—A clear, pale, straw-colored or colorless, oily liquid, almost inodorous, and having a mild, nutty taste. Only slightly soluble in alcohol; soluble in ether and in chloroform in all proportions. It should be kept in well-stoppered bottles, in a cool place.

Dose.—1–4 fluidrams (4.0–8.0 Cc.) [1 fluidounce (30 Cc.), U. S. P.].

Expressed oil of almond is contained in unguentum aquæ rosæ.

Physiological Action and Therapeutics.—The expressed oil of almond is a peculiarly bland and agreeably efficient demulcent and emollient, being used both externally and internally for the same purposes as olive oil.

Ōleum Līni—Ōlei Līni—Linseed Oil. *U. S. P.*

(OIL OF FLAXSEED.)

Origin.—A fixed oil expressed without heat from the seed of *Linum Usitatissimum* L.

Description and Properties.—A yellowish or yellow oily liquid, having a slight, peculiar odor, and a bland taste. When exposed to the air it gradually thickens and acquires a strong odor and taste; when spread in a thin layer on a glass plate, and allowed to stand in a warm place, it is gradually converted into a hard, transparent, resin-like mass. Soluble in about 10 parts of absolute alcohol, and, in all proportions, in ether, chloroform, benzin, carbon disulphide, or oil of turpentine. Linseed oil should be kept in well-stoppered bottles.

Dose.—½–2 fluidounces (15.0–60.0 Cc.) [1 fluidounce (30 Cc.), U. S. P.].

Physiological Action and Therapeutics.—The action and uses of flaxseed oil are similar to those of olive oil. One of its most important uses, when mixed with an equal quantity of lime water, is in the treatment of *burns*.

The linseed itself is used extensively as a domestic demulcent in the form of a tea, for *cough*, etc., while the ground linseed makes an excellent poultice for all *deep-seated inflammations*.

Acăcia—Acăciæ—Acacia. *U. S. P.*

(GUM ARABIC.)

Origin.—A gummy exudation from *Acacia Senegal* Willdenow, and other species of acacia, small trees, about 20 feet (6 M.) high, found in India and Africa, especially in the district of Khartoum, westward to Senegambia.

Description and Properties.—In roundish tears of various sizes, or broken into angular fragments, with a glass-like, sometimes iridescent fracture, opaque from numerous fissures, but transparent and nearly colorless in thin pieces; nearly inodorous, taste insipid, mucilaginous; insoluble in alcohol, but soluble in water, forming a thick mucilaginous liquid. Acacia should be slowly but completely soluble in 2 parts of water.

Official Preparations.

Mucilăgo Acăciæ—Mucilăginis Acăciæ—Mucilage of Acacia (34 per cent.). —*Dose*, freely.

Sy̆rupus Acăciæ—Sy̆rupi Acăciæ—Syrup of Acacia.—*Dose*, freely.

Acacia is contained in **Emulsum Amygdalæ, Pulvis Cretæ Compositus,** and in some trochisci.

Physiological Action and Therapeutics.—Acacia is a valuable demulcent, and gum-water is in ordinary use to serve as a protective to inflamed and irritated mucous membranes of the respiratory, alimentary, and genito-urinary tracts, as in cases of *pharyngitis, laryngitis, dysentery, gastritis, typhoid fever,* and in *febrile affections* generally. The mucilage of acacia is sometimes used as a protective for superficial *burns, excoriations,* etc.

Ŭlmus—Ŭlmi—Elm. *U. S. P.*

(SLIPPERY ELM.)

Origin.—The inner bark of *Ulmus fulva* Michaux, a medium-sized tree, from 30 to 60 feet (9–18 M.) high, found in the United States and Canada.

Description and Properties.—In flat pieces, varying in length and width, about ⅛ inch (3 Mm.) thick, tough, pale-brownish white, the inner surface finely ridged; fracture fibrous and mealy; the transverse section delicately checkered; odor slight, peculiar; taste mucilaginous, insipid.

Official Preparation.

Mucilăgo Ŭlmi—Mucilăginis Ŭlmi—Mucilage of Elm.—*Dose*, freely.

Physiological Action and Therapeutics.—Elm is a decided demulcent and possesses nutritive properties. It is pleasant to the taste and does not readily disturb the stomach. It is principally used as a demulcent in diseases of the gastro-intestinal and genito-urinary tracts, as *diarrhea, dysentery, cystitis, urethritis,* etc. The fibrous bark is molded into tents used to dilate the neck of the *uterus, fistulous openings,* etc.

In the form of troches (elm lozenges) ulmus is excellent in the treatment of sore throat.

Althæa—Althææ—Althæa. *U. S. P.*

(Marshmallow.)

Origin.—The dried root of *Althæa officinalis* L., a perennial herb indigenous in the temperate portion of Northern and Western Asia and in the greater part of Europe.

Description and Properties.—In cylindrical or somewhat conical pieces, from 4 to 6 inches (10–15 Cm.) long, about ½ inch (12.7 Mm.) thick, deeply wrinkled, deprived of the brown corky layer and small roots; externally white, marked with a number of circular spots, and of a somewhat hairy appearance from the loosened bast-fibers; internally whitish and fleshy. It breaks with a short, granular, and mealy fracture, and has a faint, aromatic odor and a sweetish, mucilaginous taste. It contains *asparagin*, mucilage, sugar, and pectin.

Physiological Acion and Therapeutics.— Marshmallow is emollient, demulcent, and protective, and is an efficient protective and emollient in *irritable and inflamed conditions of the skin*, and a highly efficacious demulcent in all inflammatory and irritable conditions of the *respiratory*, *digestive*, and *urinary organs*.

Tragacăntha—Tragacănthæ—Tragacanth. *U. S. P.*

Origin.—A gummy exudation from *Astragalus gummifer* Labillardière, or from other species of *Astragalus*, low shrubs, indigenous in a portion of the territory lying between Eastern Persia and Greece.

Description and Properties.—In narrow or broad bands, more or less curved or contorted, marked by parallel lines or ridges, white or faintly yellowish, translucent, horn-like, and tough. It contains 33 per cent. of a gum, *bassorin*, which is only slightly soluble in water.

Official Preparation.

Mucilăgo Tragacănthæ—Mucilăginis Tragacănthæ—Mucilage of Tragacanth.—*Dose*, freely.

Physiological Action and Therapeutics.—Tragacanth is demulcent and nutritious, and may be used for the same purposes as acacia, Iceland moss, etc. The mucilage of tragacanth is singularly efficacious as a soothing emollient in *chapped hands* and irritable conditions of the skin.

Săssafras Medŭlla—Săssafras Medŭllæ—Sassafras Pith. *U. S. P.*

Origin.—The dried pith of *Sassafras variifolium* (Salisbury) O. Kuntze, a tree indigenous in North America.

Description and Properties.—In slender, cylindrical pieces, often curved or coiled, light, spongy, white, inodorous, and insipid. Macerated in water, it forms a mucilaginous liquid, which is not precipitated by the addition of alcohol.

Official Preparation.

Mucilăgo Săssafras Medŭllæ—Mucilăginis Săssafras Medŭllæ—Mucilage of Sassafras Pith.—*Dose*, freely.

Physiological Action and Therapeutics.—Mucilage of sassafras pith is an agreeable demulcent and a mild local stimulant, and

may be used for the same purposes as slippery elm, tragacanth, acacia, etc. It forms a pleasant vehicle for more active remedies.

Chŏndrus—Chŏndri—Chondrus.

(IRISH MOSS.)

Definition.—The dried plant of *Chondrus crispus* (L.) Lyngbe.

One part of chondrus boiled with 30 parts of water yields a solution which gelatinizes on cooling.

Dose.—As a demulcent drink, 15 grains (½ ounce), U. S. P.

Kaolīnum—Kaolīni—Kaolin. *U. S. P.*

Definition.—A native aluminum silicate, consisting largely of the pure silicate, $H_2Al_2Si_2O_8 + H_2O$. It is a very pure clay.

Properties.—Soft, white or yellowish-white powder, odorless, and having an earthy or clay-like taste.

Insoluble in water.

Kaolin is contained in *Cataplasma Kaolini* (q. v.). It is used in dusting-powders; also in pills containing easily reduced bodies, such as silver nitrate or potassium permanganate, which cannot be mixed with ordinary excipients.

Official Preparation.

Cataplăsma Kaolīni — Cataplasmătis Kaolīni — Cataplasm of Kaolin (U. S. P.).—Introduced in response to a request for an external clay preparation; similar to a number of commercial articles. The constituents are kaolin (57.7 per cent.), boric acid, methyl salicylate, glycerin, and small quantities of thymol and oil of peppermint.

Used as a poultice in mild local infections. Usually applied hot.

Tălcum—Tălci—Talc. *U. S. P.*

Definition.—A native hydrous magnesium silicate, official under the same name in the German Pharmacopœia.

Many of the commercial talcum powders contain talc and boracic acid.

Properties.—Talc occurs as a grayish-green solid with waxy luster, or a white or pale-gray powder. It feels greasy to the touch, hence it is popularly called soapstone. It is used as a dusting-powder, and in some pill-masses.

Tălcum Purificātum—Tălci Purificāti—Purified Talc. *U. S. P.*

Talcum purified by treatment with hydrochloric acid. Used in the pharmacopœial method of preparing certain official waters of volatile oils.

The same preparation is to be found in the National Formulary.

Cerātum Rĕsinæ Compŏsitum—Cerāti Rĕsinæ Compŏsita—Compound Rosin Cerate. *U. S. P.*

Composed of rosin, yellow wax, suet, turpentine, and linseed oil.

Emplăstrum Adhæsīvum—Emplăstri Adhæsīvi—Adhesive Plaster. *U. S. P.*

This is to take the place of Emplastrum Resinæ (U. S. P., 1890), from which it differs chiefly in the substitution of rubber for rosin.

For formula and method of preparation see the Pharmacopœia.

Paraffīnum—Paraffīni—Paraffin. *U. S. P.*

Definition.—A mixture of solid hydrocarbons, chiefly of the methane series. The paraffin of the U. S. Pharmacopœia melts between 51.6° and 57.2° C. (124.9°–135° F.). The "hard paraffin" (paraffinum durum) of the British Pharmacopœia melts between 54.4° and 57.2° C. (129.9°–135° F.), while the "paraffinum solidum" of the German Pharmacopœia melts between 74° and 80° C. (165.2°–176° F.).

Gelatīnum—Gelatīni—Gelatin. *U. S. P.*

The U. S. Pharmacopœia demands that upon ignition it leaves not more than 2 per cent. of ash. Most of the gelatin on the market has an acid reaction.

Lycopōdium—Lycopōdii—Lycopodium. *U. S. P.*

Origin.—The spores of *Lycopodium clavatum* L. and of other species of lycopodium, low-creeping perennials found in dry woods, distributed over the greater portion of the globe.

Description and Properties.—A fine powder, pale yellowish, very mobile, inodorous, tasteless, floating upon water and not wetted by it, but sinking upon being boiled with it, and burning quickly when thrown into a flame. Under the microscope the spores are seen to be sphero-tetrahedral, the sufaces marked with reticulated ridges, and the edges beset with short projections. Lycopodium contains a fixed oil and a minute quantity of a volatile base, methylamine.

Used principally externally.

Physiological Action and **Therapeutics.**—Lycopodium is an admirable protective, and possesses great power of absorbing oils. Its lightness, dryness, and absorptive power render it an excellent dusting-powder for excoriated surfaces, *eczema*, *herpes*, *intertrigo erysipelas*, superficial *ulcers*, etc.

Its peculiar property of not being wetted with water makes it a valuable protective to prevent *irritation* or *chafing* caused by the urine or alvine dejections of infants.

The drug is used as a basis for insufflations and in pharmacy to prevent the adhesion of pills.

Unguĕntum—Unguĕnti—Ointment. *U. S. P.*

White wax, 20; benzoinated lard, 80, constitute the base of simple ointment. Another emollient ointment is Unguentum Aquæ Rosæ.

ANIMAL EXTRACTS (ORGANOTHERAPY).

THE striking fact that various excretions and tissues of the living organism, when administered under certain conditions, possess a peculiar therapeutic value is now well ascertained. The idea, although generally considered an innovation in therapeusis, has long been the subject of studious attention, yet only in recent years has the practical application of organotherapy claimed professional recognition, and the nature and operation of its curative properties acquired unprecedented significance. Extracts derived from almost every portion of the human system, together with many animal secretions, have been prepared, and their efficacy tested by searching experiment. It was reserved for the noted investigator, Brown-Séquard. and his associates to inaugurate, as late as 1889, the system of organotherapeusis as known to-day and promulgate the theory resulting in the now-established medicinal potency of glandular extracts.

Among the earliest and most original essays prompted by the new procedure was Brown-Séquard's hypodermic injection of an extract from the recent testicles of mammals, in the treatment of *senile debility*. It should be noted, in passing, that, curiously enough, as there is no new thing under the sun, this special employment of organic extract for the relief of morbid conditions finds an analogue in a custom of very ancient origin, the high authority of Pliny, the historian, attesting that the Grecian and Roman debauchés were wont to consume the testicles of asses to restore their dissipated energies.

While it must be admitted that the benefits derived from the administration of testicular juice have failed to realize the ardent anticipations of its earlier advocates, we may cheerfully concede that the experimental impetus imparted by it to clinical and therapeutic investigation has added considerably to our scientific knowledge in the realm of medicine and gone far to alleviate the ills of suffering humanity.

The study of the internal secretions threatens to revolutionize physiology; and we must remember the position in which this matter stood, and still stands, in relation to our knowledge of the cell and of cell action. The conclusions reached by Dr. Sajous bid fair to change the entire basis of our conception of physiologic function, and consequently of therapeutics.

The profundity of Sajous's work necessarily impedes its speedy acceptance, for the number of those capable of comprehending it, and even giving the requisite time to it, is small. But the least that can be said by any capable observer who has examined his theory is that Sajous has earned the right to a hearing; and this insures the acceptance of what is assimilable in due time.

Glăndulæ Thyrōideæ Sĭccæ—Glandulārum Thyroidārum Siccārum—Desiccated Thyroid Glands. *U. S. P.*

Definition.—The cleaned, dried, and powdered thyroid glands of the sheep, freed from fat.

Description and Properties.—A yellowish amorphous powder, having a slight, peculiar odor; partially soluble in water.

Dose.—Average dose: 4 grains (0.250 Gm. = 250 milligrammes), U. S. P.

Numerous extracts of the thyroid are upon the market, many of them purporting to be the active constituent. *Aiodine*, *opothyroidine*, and *thyroglandine* are other preparations on the market.

Thyreoidectin and *rodagen* represent a new series of preparations quite recently introduced which must not be confused with the above; their action is stated to be exactly the opposite of that of the thyroid preparations. *Thyreoidectin* is prepared from the blood, *rodagen* from the milk, of animals from which the thyroids have been removed.

Numerous chemical studies made during the past few years have seemed to show that the action of the thyroid extract is due to a peculiar body rich in iodine. It is found principally in the colloid substance of the gland, and is rich in globulin, a thyreoglobulin from which a principle, *iodothyrin*, has been insolated. Although much remains to be learned concerning this *iodothyrin*, it is safe to assume it as the *active principle* of the gland. It varies greatly in amount in different glands and at different ages in the human subject.

The most rational and successful application of organotherapy, perhaps, was that of Murray in 1891, who, following Horsley's deductions from Kocher's surgical results, proposed the subcutaneous injection of a *thyroid extract* in the treatment of *myxedema*, many cases of which have improved, while others have been definitely cured by the adoption of the remedy. The preparations in this case have included the ingestion of the dry powder, the injection of a glycerin extract, and the raw or partially cooked gland administered as food. The testimony of competent authorities amply attests the efficacy of the agent, which now receives almost universal acceptance. It has, therefore, been made official in the Pharmacopœia of 1900.

Action.—If injected into the veins of animals, iodothyrin causes an acceleration of the heart action, lowers the blood-pressure, increases the amount of urine excreted, and may give rise to dyspnea and diarrhea. It seems probable that many of the peculiar toxic symptoms that were observed when the older extracts were in use were in reality due to the presence of putrefactive ptomains. In large doses, in man, symptoms somewhat similar to those observed in exophthalmic goiter have been reported. Iodothyrin has also the effect of increasing catabolism and produces a marked breaking-down of proteids, in this way causing loss of flesh. This effect, combined with its diuretic action, renders it valuable in the treatment of obesity.

Therapeutics.—With the treatment of myxedema, cretinism, Basedow's disease, lipomatosis universalis, cachexia strumipriva, and thyroid insanity, it would seem as if the use of thyroid had reached its limitations. The successful administrations and beneficial results

obtained in some of the above diseases, however, have stimulated many observers and experimenters to make a wider trial of this form of medication. Psoriasis has been helped by its use.

The dosage, method of administration, and danger-signals are no less important than the indications for its use. The hypodermic administration of the liquid extract and the grafting of the fresh gland have long fallen into disuse, and the tendency of the present day is to administer the powder or to give tablets or capsules prepared from the desiccated fresh gland. The dose varies with the individual, and for this reason it is advisable to begin with small doses, which should be gradually increased until the desired effect is produced. Beginning with 1 or 2 grains a day, as much as 15 grains may be administered, the prescriber always being on the *qui vive* for poisonous symptoms. During the course of administration especial attention should be given to the respiratory and cardiac apparatus, and at the first appearance of rapid pulse, embarrassed respiration, rise of temperature, vertigo, or gastric disturbance, its use should be abandoned.

Improvement has been noted in several cases of malignant *syphilis*, Menzies considering that thyroid acts as a powerful skin-tonic and a useful adjuvant to mercury and potassium iodide in the treatment of this disease.

The favorable results often attending the partial employment of animal agents in diseases of corresponding organs, and especially the noteworthy benefits derived from the application of the thyroid treatment in myxedema, have suggested the preparation of many extracts of varying efficacy.

PARATHYROID GLAND.—These glands when given in animals are capable of causing muscular tremor and other symptoms. It has been suggested that they may prove of value in treating pathological tremors, particularly *paralysis agitans.*

THYMUS GLAND—This organ contains bodies rich in iodine similiar to those found in the thyroid, but as yet no therapeutic application has been followed by marked success.

PITUITARY BODY.—Inasmuch as acromegaly has been found to be associated very frequently with disease of the pituitary body it has been suggested that this body might be of some service, but thus far success in its use for this disease has been negative. The gland is a complex structure anatomically, and further research may give some results.

NUCLEIN is a complex proteid body, characterized by its large percentage of phosphorus. The phosporus exists in the form of nucleinic acid; so far as is known, this acid is the same in all cells, yet the basic part differs in various nucleins.

When administered hypodermically or orally, nuclein increases the number of leucocytes in about three hours. The amount of increase varies with the subject; it may be slight or it may be three-fold; it occurs principally in the polynuclear cells.

Nuclein is of some value in conditions of infection where the

symptoms are due to general invasion of the bacteria. Favorable results are obtained in simple *anemias*. It is found on the market in a 5 per cent. solution, dose 1 to 2 drams. It should be given on an empty stomach. Vaughan reports that in *tuberculosis* the effect of moderate injections has been to lower the temperature, without untoward manifestations. *Indolent ulcer* has yielded completely to a similar treatment.

It is also stated upon high authority that the nucleins are useful in "all forms of *anemia*, in chronic and recurrent *malaria*, in *digestive disorders*, and in acute and chronic *pulmonary affections*" (Aulde), the nuclein adopted being obtained from the thyroid and thymus glands. The latter author suggests the use of nuclein in the treatment of *typhoid*, in which disease the activity of leucocytosis is defective.

BILE.—This has already been treated.

BONE-MARROW has proved efficacious in *anemia* (Dickson, Frazer), and has also been employed by Filleau in *tuberculosis*.

PANCREAS EXTRACTS.—These have been employed in diabetes, but as yet very crudely and with no effect.

Careful technic is desirable in the use of this class of bodies, and their further study may be crowned with brilliant results.

SUPRARENAL GLANDS.—These have already been discussed.

SERUM-THERAPY.

Among the marvels of scientific research which have distinguished our century no achievements are more remarkable, nor of greater moment to the welfare of mankind, than those pertaining to the field of biologic, pathologic, and therapeutic investigation. The limits of the present work preclude a detailed treatment of so extensive and complicated a subject; yet a brief summary, elucidating the theory and development of serum-therapy as exemplified in contemporaneous research, should be of interest, as well as benefit, to the student of modern therapeutics.

A glance at the history of therapeutic procedure in the prophylactic treatment of infectious diseases shows that the general principle underlying all later discoveries had been, though crudely, divined at a much earlier period than we are wont to suppose. In view of actual attainment it is natural that the mind should revert to the transcendent services rendered to mankind by Jenner; yet it is known that the ancient Hindus and Persians, as well as the nomad tribes and caravans of farther Asia, practised inoculation of equine virus, or *horse-pox*—the mammary pustule developed during early lactation in the horse, camel, and cow, and even in woman.

The inoculation of human virus is of immemorial origin, probably coeval with the importation of variola from Asia into Africa by the Saracens. Certain it is that as early as the tenth century the Arabs and Chinese adopted the custom of variolization, the inoculation of small-pox, although the skeptical physicians of the age

consigned the practice as a monoply to women. Of the developments of the treatment for small-pox we refer to special works.

It was reserved for Jenner, however, in 1776, to commence the systematic and exhaustive study of the subject destined to prove inestimably beneficial to mankind. His early experiments were but a repetition of the empirical, yet prophetic, test of the English farmer; and it was not until 1798 that Jenner published his first paper upon the subject, vaccination being transported to America in the following year. Such is the brief, yet eloquent, record of an achievement which experience has proved to be of incalculable benefit to man. To-day there is no question among the more enlightened members of the profession that the operation, *properly performed*, is an absolute safeguard against the infection of small-pox.

Strange, indeed, is it that a century of comparative quiescence should have elapsed since Jenner pointed the way to the startling accomplishment of the present epoch. Yet not until Pasteur, in 1880, announced to the world the issue of his labors touching the protective inoculation of animals was the broken thread of pathogenic research taken up anew, and the task of solving its mysteries resumed—be it said with more profound acumen and far more complete appliances than ever before.

It is a matter of record how the French savant demonstrated that cultures of the bacilli of chicken-cholera, when thoroughly dried and long exposed to the air, lost their virulence, and that fowls inoculated with the attenuated virus were rendered insensible to the attacks of more energetic micro-organisms. It was, *mutatis mutandis*, a modification or development of the Jennerian principle: "The history of vaccination constitutes the first step in a long series of labors inspired by the admirable discoveries originating in the genius of Pasteur. The principle is always the same—to diminish the strength of the virus and inject it into the animal which we wish to render immune" (Bernheim).

A striking departure from Pasteur's method by Salmon and Smith, in 1886–87, led indirectly to the latest evolution of inoculative therapy. They showed conclusively that animals may be rendered immune against certain infectious diseases by inoculating them with filtered cultures containing the toxic products of pathogenic micro-organisms entirely free from the living bacteria to which they owe their origin. By this process immunity against the bacillus of hog-cholera was attained in pigeons, the disease being almost invariably fatal to these birds. A little later (1888) Roux, employing similar sterilized cultures, succeeded in protecting susceptible animals against the anthrax bacillus; and more recently (1890) Behring and Kitasato have proved that immunity against the action of the tetanus bacillus may be conferred by the use of toxic products in solution freed from the presence of active germs—in a word, that *purely chemical agents* sufficed to attain the object hitherto deemed wholly dependent upon the influence of living bacteria. The significance of this discovery could hardly be over-estimated. By

it the entire theory of causal phenomena—the protective force in which the immunizing property was supposed to reside—became modified. If not a living organism, but a chemical substance, proved to be the immunizing agent, then resistance to toxic influences must proceed from some source other than bacterial metabolism—some organic force inherent in the inoculated system. To ascertain the nature and operation of this bactericidal power and determine the *rationale* of acquired immunity now engaged the earnest attention of savants throughout the world. It is the province of the text-book of pathology to discuss the various problems of immunity. In this work the results only of the studies as applied to Therapeutics can be taken up.

Tetanus.—The first proof that tetanus is an infectious disease, of ballicary origin, was furnished by Carle and Cattone, who in 1884 reproduced the symptoms in a rabbit by inoculation of pus taken from a human tetanus wound. The bacilli were found in the adjacent soil, but it was not until 1889 that Kitasato succeeded in isolating pure cultures, proving conclusively the microbic nature of the disease.

The earliest case treated with antitoxin was reported in 1891 by a Bolognese physician, Dr. Gagliardi, the result being very satisfactory.

In December, 1890, Behring and Kitasato demonstrated that the serum of animals rendered immune against tetanus by the injection of iodine trichloride in the blood was capable of neutralizing tetanic poison, whether in the laboratory or in other animals, the property not being possessed by organisms not inoculated. Not only did they succeed in preventing infection, but they recognized in the serum a curative power, as shown in the inoculation and cure of mice. At the same time it was observed by Vaillard that the immunity conferred by the serum was of short duration, lasting only fifteen days.

Kitasato's preventive injection—a mixture of living culture and gradually decreasing doses of iodine trichloride—was perfected by Behring, who successfully applied it to the mouse, rabbit, sheep, and horse. Various results of experimental research ensued, eliciting, among other interesting phenomena, the fact that removal of the spleen renders immunization impossible. In 1891, Vaillard showed that the serum of animals naturally immune is not antitoxic, becoming so only after a powerful dose of tetanic poison, and that the spleen and the fluids of immunized subjects are devoid of antitoxic properties.

The present status of tetanus antitoxin is not settled. It has not fulfilled all that was hoped for it, yet, injection into nerve trunks and within the cerebral substance has in the early stages proved to be of some service. Meltzer has recently suggested magnesium sulphate by intrarachidian injections, and Blake has reported a phenomenally successful result following its use.

Diphtheria.—It is in the treatment of this universal and terrible disease that serum-therapy has achieved its most signal triumphs,

the marvels wrought by its influence attracting more and more the attention both of the medical profession and of the laity.

The micro-organism of the malady was described by Klebs in 1883, his investigations being quickly followed by those of Loeffler, who confirmed Klebs' discovery and announced that it was possible not only to insolate, but also to produce, cultures of the microbe.

Sērum Antidiphthĕricum—Sēri Antidiphthĕrici—Antidiphtheritic Serum.

(DIPHTHERIA ANTITOXIN.)

Definition.—A fluid separated from the coagulated blood of a horse immunized through the inoculation of diphtheric toxin (U. S. P.). The German Pharmacopœia recognizes also the dried serum.

Antidiphtheric serum gradually loses its power, the loss in one year varying between 10 and 30 per cent. "The standard of strength, expressed in units of antitoxic power, should be that approved or established by the U. S. Public Health and Marine-Hospital Service" (U. S. P.). All manufacturers selling diphtheria antitoxin in the District of Columbia, or in States other than the one in which it is manufactured, must secure a license issued by the Secretary of the Treasury, on recommendation of the Surgeon-General of the Public Health and Marine-Hospital Service.

Dose.—Average dose: 3000 units. Immunizing dose for well persons, 500 units (U. S. P.).

The serum has now been made official in the U. S. Pharmacopœia.

Caution.—Should be kept in sealed glass containers in a dark place at temperatures between 4.5° and 15° C. (40° and 59° F.).

From a careful consideration of the subject in its relations to diptheria, we may safely conclude:

1. That immunized serum forms a remedy which experience proves to be wholly innocuous and eminently adapted for use in human infection.

2. That antidiphtheritic serum has in every respect corresponded with the most sanguine hopes of its advocates, its employment being attended with astonishing success wherever properly used and in sufficient quantities.

3. Finally, that it is incontrovertibly established that by means of injecting serum temporary immunity from infection may be readily conferred, permanent protection being contingent merely upon a renewal of treatment.

The present status of diphtheria antitoxin may be presented in a few words. It has established itself as a specific in the treatment of this disease. During the past year the use of larger doses has become more general, and it seems certain that better results are obtained. The administrators of the Chicago Department of Health give 2000 units in all cases of suspected diphtheria, and employ 1000 units as an immunizing dose. During the months of November and December this department treated 219 cases of bacteriologically proved diphtheria, all charity cases, with a death-rate of 4.1 per cent. Some two and a half years ago, when antitoxin was not used, the death-rate from diphtheria treated by this department was about 35 per cent.

Tuberculosis.—It may be stated, in general terms, that the microbic nature of tuberculosis was admitted by nearly all writers upon the subject before the discovery of the pathogenic micro-organism. Villemin in 1866 had established by experiment the infectious character of the malady; but in France the idea seemed almost revolutionary, creating no enthusiasm, it being reserved for Germany, through the indefatigable labors of Robert Koch, to develop and elucidate the theory conceived by Villemin. Koch discovered the bacillus of tuberculosis, and even succeeded in isolating and cultivating it, the pure cultures obtained by him always producing tuberculosis in every form. His original communication, addressed to the Physiological Society of Berlin, bore date of April 10, 1882, and at once stimulated experimental research in others, who fully confirmed his discovery.

Various methods of inoculation have been adopted in tuberculosis: 1, Inoculating the patient with another disease; 2, inoculation with attenuated tuberculosis or that proceeding from a different species, as from birds; 3, inoculation of the soluble bacillar products—tuberculin; 4, injection of blood taken from animals often immune against tuberculosis; 5, injection of serum drawn from inoculated animals; 6, finally, injection of serum taken from immunized animals. With the last two of these methods we are properly concerned. The fifth has been scientifically adopted by Babès, Richard, and Héricourt, who have treated a large number of cases in which various cures have been effected. The main obstacle of the procedure lies in the difficulty of successful inoculation, the greater part of the animals employed dying of infectious nephritis.

By the sixth method, as employed by Bernheim, this fatality is largely obviated, a careful procedure with the serum of immunized animals proving the most efficacious hitherto devised. The process of immunizing consists in injecting the toxic products normally secreted by Koch's bacillus, and is, in effect, that adopted by Behring in preparing the antitoxin of diphtheria. In experimenting upon a large number of animals, suffice it to say that the results obtained by Bernheim were eminently satisfactory, every case indicating improvement, and the actual cures being about 40 per cent. So convinced was he of the sovereign value of his method that he emphatically declared it to be the only rational procedure possible in tuberculosis. Within recent years Magliano and Behring have announced important advances in the serum or vaccine treatment of tuberculosis.

It is difficult to sum up in a few words the present status of the serum treatment of tuberculosis. We are not in the possession of any true antibodies that are of service in the direct treatment of patients suffering from tuberculosis, but there are excellent reasons for believing that an immunizing serum or vaccine is a possibility in the not-far-distant future.

Pneumonia.—Inoculations of attenuated virus readily confer im-

munity in lower animals, reduction of virulent germs be attained by the use of desiccated pneumonic viscera. The saliva of a patient, collected after defervescence, ensures protection to the mouse, the same being true of blood-serum. Immunization of animals was inaugurated by Emmerich and Fovitsky in 1891, subsequent investigators confirming their experiments under varying conditions, Foa and Scabia finally employing human serum in the inoculation of rabbits with marked success.

The therapeutic interest of the subject centers in the application of inoculation to man. The early experiments of Foa and Scabia were without result, neither reaction nor amelioration attending their treatment; but in 1892, Klemperer reported favorably concerning immunization in 40 cases of human pneumonia.

In January, 1893, Lava communicated to the Academy of Medicine in Turin the application of serum-therapy with auspicious results. Ruzzolo also reported successes. Up to the present time, however, it cannot be said that a successful pneumococcus serum has been devised.

Cholera.—The microbe of this terrible disease had been sought since 1848, yet the subject had never been profoundly studied until Koch succeeded in isolating the germ. Being associated with other micro-organisms, the bacillus had remained undetected, being distinguishable, in fact, only in fulminant attacks of the disease, as was noted by Strauss and Roux.

Haffkine has definitely produced results in the immunization against cholera. He has used his serum on a large scale in India, and his results are encouraging.

Septicemia.—The streptococcus of Fehleisen (erysipelatis), which causes erysipelas, was discovered by Nepveu, in France, and Hüter, in Germany (1868–80), and has been the subject of careful study by Klemperer and others, in the hope of determining its availability as an immunizing agent. Employing the serum of immunized rabbits, it has been found possible by intravenous injection to cure the disease in mice, the serum proving efficacious only against the disease with which the animal supplying it was inoculated. Subsequent experiments have been attended with varying results, Marmorek, in February, 1895, having succeeded in obtaining a germ of streptococcus so virulent that the hypodermic injection of $\frac{1}{100000}$ Cc. was fatal to the rabbit in thirty hours. Inoculation with this microbe or its toxins conferred immunity upon rabbits, which furnished a preventive and curative serum.

Encouraged by previous experimentation, Charrin and Roget now sought to apply the method of serum-therapy in the treatment of puerperal fever. Having satisfied themselves of the curative property of the serum of a mule inoculated with the microbe of erysipelas, collected fifteen days after the eighth inoculation, they injected subcutaneously 8 Cc. of serum in a woman affected with the fever. The report is as follows: "The next day no improvement. A second injection of 8 Cc. Next day condition slightly

improved, but still serious. Third injection of 25 Cc. Result, on the following day rapid improvement; decline of fever; general good health; and early establishment of convalescence."

Antistreptococcic serum gives promise of being second only to the diphtheria antitoxin in point of therapeutic value. It has been most successful in erysipelas and puerperal septicemia. Cases of scarlet fever are reported where it has been useful in shortening the duration of the disease and preventing unfortunate complications and sequelæ, such as otitis media and other suppurative processes due to streptococci. Aronson has perfected an antistreptococcic serum from which much is hoped.

The latest reports on antistreptococcic serum are not so encouraging as the earlier ones.

Syphilis.—The pathogenic source of syphilis is still being sought. The most recent work of Schaudinn and Hofmann, corroborated by Flexner, Noguchi, Metschnikoff and others, would seem to show that a spiral organism, *Spirochæta pallida*, bears some relationship to the disease. Experimental inoculation has succeeded for lower animals, and the way seems to be opening up for a possible serum therapy of syphilis.

Typhoid Fever.—The bacillus of this disease was first detected in the kidneys by Bouchard in 1879. The name was given by Eberth, who studied the germ in 1880–81. The old cultures contain an exceedingly toxic ptomain, besides a soluble substance capable of inoculating animals.

Wright and Semple have devised a method of vaccine immunization against typhoid which promises well. Bokenham has produced a serum, but results are as yet too few to justify therapeutic conclusions.

Reptile Poisons.—It has long been known that certain animals (reptiles) possess natural immunity against their own venom. The poison of the toad having been detected in his blood, the reptile's immunity was at first thought to be due to tolerance, the same condition existing in the salamander and viper.

So far as it affects man, Calmette announces that he has employed serum with success in the treatment of snake-bites, even to the extent of curing them.

Calmette's antivenin has now become perfected and is found a reliable mode of treating cobra-poisoning.

Noguchi has in course of preparation an anticrotalic serum, against rattlesnake-poisoning, which promises well, although not yet perfected.

Carbuncle (Anthrax).—The bacterium of anthrax, of the genus bacillus, has proved a subject of elaborate and interesting experiment, many features of which are of absorbing interest alike to the bacteriologist and the clinician. The animals subjected to inoculation have been chosen with great care, and those supplying the immunizing serum include many species. The general results of

protective inoculation may be regarded as useful for sheep, but for man no reliable serum is known.

Rabies.—In January, 1881, Galtier announced that intravenous inoculation of rabid saliva confers immunity upon sheep, confirming his experiments later in the year by injecting the fluid into nine sheep and one goat. Pasteur, Chamberland, Roux, and Thuiller pursued experiments in a similar line, with somewhat negative results.

By passing the virus successively from dogs to monkeys, Pasteur was able to attenuate its virulence, and finally, by transferring the poison from monkeys to rabbits, a serviceable immunizing agent was obtained, still further experiments perfecting the method in view.

Satisfied with his success, Pasteur now turned his attention to the inoculation of man against hydrophobia. The first operation (in 1885) was attended with auspicious results, and from that moment the savant's laboratory was invaded by affected individuals demanding cure. Institutes were founded in various parts of the world, that in Paris being the center of bacteriological study in France. In America the subject has received wide attention, but in many instances the benefits derived from Pasteur's inoculative procedure have been held to be of doubtful importance by intelligent observers.

Pasteur's treatment of hydrophobia is based on the fact that rabic virus may be intensified or attenuated at will. If successive inoculations be made into rabbits with fluid taken either from the dog or the monkey, the virulence may be so increased above that of a street-dog, requiring from twelve to fourteen days for incubation, that after about one hundred inoculations the period of incubation may be reduced to seven or even six days. This, the most powerful virus yet attained, Pasteur termed *virus fixe*. When protected from light and air this virus retains its strength for a long period. Pasteur further observed that the cords of rabbits which had been dead for some time contained a less virulent poison than those of animals freshly killed, especially when the air was dry and the cord protected from putrefactive influences, the most efficient inoculation being that of an emulsion made from cords exposed to dry air for ten and fourteen days, followed by emulsions of cords exposed for shorter periods.

With regard to the administration of serum, several precautions are of great importance. The absolute cleanliness of the syringe, for example, should be an object of especial care. To this end a glass barrel is preferable, in order that impurities may be readily detected and removed. For packing purposes rubber or asbestos should be employed, and the instrument should be so constructed as to permit cleansing and sterilizing of every part before and after use.

The mode of injection and the amount of dosage (measured in antitoxin units) vary somewhat according to the nature of the dis-

ease and the age and susceptibility of the patient. Care should be taken to use only the most reliable preparations.

It has been impossible to present within a necessarily limited space the entire field covered by this profoundly interesting subject. For a multitude of details, embodying a wide range of experimentation, and for many expressions of individual opinion awakened by a consideration of so-absorbing a theme, the student is referred to the extensive bibliography relating to every phase of serum-therapy.

It may be readily imagined what would have been the discussion of Jenner's vaccination had our bacteriological and chemical knowledge and delicate appliances for investigation existed in his day. It is scarcely surprising, therefore, that the renewal of similar studies, after an interval of unprecedented scientific progress, should elicit from all parts of the world a zeal and enthusiasm impossible in any previous epoch, together with a mass of concurrent or dissenting testimony touching new discoveries proportionate to the greatly increased number of competent investigators. Whatever be the limitations of serum-therapy, the consensus of opinion among thoughtful observers is that its importance to mankind and its purpose are deeply rooted in the eternal laws of matter and the methods of great Nature. Its rationale, its mysterious power, and startling phenomena awaken new and greater problems of bacteriological science; yet, though the entire subject, embracing as it does so ample and momentous a field of inquiry, remains *sub judice*, the character of modern scientific investigation must surely reveal its truth or falsity.

OPSONINS, OPSONIC INDEX, AND VACCINE THERAPY.

For the last ten or fifteen years especially close attention has been given in medical research to ascertain how it is that the body itself resists disease and throws it off. Why is it that certain animals or groups of animals show great susceptibility to certain diseases, especially those of bacterial origin, and other groups show immunity to such infections? Why is it that one organism shows different degrees of resisting power at different times and under different conditions? What are immunity and susceptibility, and upon what factors do they depend? Over these essential questions have been working some of the greatest minds of modern medicine, and many truths have been discovered and principles established upon which is rapidly being built definite lines of practical therapy. The mortality of certain diseases has already been materially reduced because the underlying individual factors in their etiology have been found and these factors have been either destroyed entirely or their action restricted by definite methods based upon definite physiological, chemical, and pathological facts.

Among the many discoveries in such work which seem to be well-founded falls the subject of opsonins, and at the present time

there is no more "live" subject in the current literature than that of opsonins. That there *are* such chemical bodies in the blood-serum as opsonins has been pretty definitely settled. Just what bearing these bodies have upon the question of susceptibility and immunity is by no means yet settled. At the most they are only one factor among the many. Their comparative value or importance relative to the other factors is not determined. The discovery of opsonins and their *evident* importance; the attractive lines of research work that the study of opsonins offer, and the results of a practically new therapy against bacterial disease have attracted the attention of the medical world. To-day not only the laboratories are busy establishing the status of opsonins from a physico-chemical standpoint, but practitioners in practically all specialties are collecting clinical data from the vaccine therapy, that is based, as far as we yet know, upon opsonins.

As is well known, the investigator who has named these certain chemical bodies that are in the blood-serum opsonins is Sir A. E. Wright, of London. It is due to his observations that their identity was established and the practical technique of vaccine therapy based.

The subject of opsonins falls under the larger heading of phagocytosis when we consider the main divisions of immunity. The blood has three principal methods of resisting bacterial invasion: (1) A bacterial destroying action (bactericidal); (2) an antitoxic action, and (3) a phagocytic. In other words, the blood assists the body to oppose the pathogenic germs by killing some varieties; by neutralizing the poisons that other varieties secrete (such as the case of the diphtheria bacillus), and finally by destroying still other varieties by the devouring action of the white blood-cells.

Opsonins have only to do, as far as is known, with the last method, and in fact opsonins are chemical bodies in the serum that aid in the destruction of pathogenic germs by causing them to be devoured by the white blood-cells. The assistance is given in this way: The invading germ is first neutralized by these chemical bodies, opsonins, which come in contact with it, and only then can the germs be taken up by the white cells. Just what the interaction is between germ and opsonin is not known, but most investigators consider it best explained by the so-called Ehrlich's "side-chain theory." The active germ is supposed to possess numerous unsatisfied arms or radicles, by which it combines other cells, just as is the case in the simpler bodies of organic chemistry. Until these radicles are satisfied it has been found that the germ is not devoured by the phagocytic white blood-cells. The opsonins in the serum are chemical bodies that neutralize these arms, and when the germs are bathed with a serum containing opsonins, these germs become neutralized and can be and *are* then taken up and destroyed by the white blood-cells, evidently because all these attacking arms have been made powerless. To go into the theory a step further, it is thought that one method by which a pathogenic germ injures or destroys a living body-cell is first by "fastening" itself to the cell by these arms of union (the body-cell has like unsatisfied arms).

and then pouring into the cell-body its cell-destroying elements. The opsonins are supposed to come into this close chemical union with the germ. The germs are at least so neutralized or acted upon by the opsonins that they can now be taken up by the leucocyte when they could not have been taken up before they were so neutralized. In this way the opsonins aid phagocytosis, and their importance is very great if it be found that phagocytosis *is* the principal factor of immunity and susceptibility to bacterial insult. Many of the foremost investigators, like Metchnikoff, believe this is so. The word "opsonin" Wright coined because it means "to prepare food for" (ὀπςομέο). The opsonins prepare the food (germ) for the devouring cell (leucocyte).

Wright found that each variety of germ was neutralized by a definite variety of opsonins—*i. e.*, the action of opsonins is specific.

Not only did Wright establish the identity of opsonins, but he also devised a method of estimating the amount or strength of them in any given serum. Further, he found that persons whose serum had, for example, a low opsonic content relative to one kind of germ, need not necessarily have a low content of opsonins which act upon some other kind of germ.

Again it was found that the serum from a person who had been suffering from some chronic infection was usually low in opsonic content as compared with the serum taken from a normal healthy individual; and likewise in acute cases of infection it was learned that the serum content of opsonins, relative to the specific bacterium causing this infection, did not remain from day to day within normal limits, but varied more or less. As the sera from many normal individuals were found to remain within definite boundaries, when examined at varying intervals, over long extent of time, this variation in the infected person's opsonic strength was considered significant.

Further, it was found by numerous estimations of the strength of opsonins in the sera of individuals suffering from the various infections that, as a rule, the patient getting worse or no better showed a lower strength than he did when getting better, or another would when *he* was recovering. Carrying out this idea further, Wright considered that one way to assist nature to resist infection was to bring about a higher strength in the opsonins of that patient's serum. It is upon this theory that vaccine therapy is based—*i. e.*, a low opsonic content of a patient's serum is raised and maintained at a higher level. This aids in the phagocytic power of the patient's white blood-cells, as explained above, and therefore works toward the destruction of the invading germ. After long months of experiment Wright has devised:

1. A method of estimating the opsonic strength of a given serum relative to a given germ.

2. A method of raising that strength, if low, and maintaining it at a high point.

In order to have some standard for comparison the opsonic content of a patient's serum is always contrasted with that of a "normal" person's serum, and the result is called the "opsonic index,"

and if the patient is, for example, a tuberculous one, we speak of the patient's tuberculo-opsonic index as being so and so. The normal index is always (arbitrarily) considered as 1. The patient's index may be 1 or above, or below 1.

In order to understand the method Wright devised for estimating the opsonic index we must consider the factors that enter into the actual mechanism of opsonification and phagocytosis in any given field of tissue. We have then:

(1) The opsonins in the patient's serum; (2) the white blood-cells, and (3) the invading germs; and then, for comparison, we must take a fourth factor—(4) the opsonins in a normal serum.

Opsonins so act upon the germs as to render them subject to phagocytosis. A serum strong in opsonins would cause more phagocytosis than one weak in opsonins. A definite amount of serum is, therefore, mixed with a definite amount of bacteria and to this mixture is added a definite amount of white cells. This mixture is all placed in a suitable receptacle and in an incubator for a certain length of time. During this incubation the opsonins have an opportunity of acting upon the bacteria, and then these satisfied bacteria are taken up by the leucocytes. To just what extent they are taken up depends the estimation of the phagocytic, and therefore the opsonic, power of the serum with which we are dealing. If we now take a drop of the incubated mixture and spreading it out on a slide, stain it with suitable stains, we can actually see and count the bacteria that have been ingested by the white blood-cells. If we count 50 or 100 cells, and the number of bacteria in each, we can estimate the average number in each cell. This is called the *bacterial average* of the patient's serum.

Now, if we go back and "run through" a similar experiment, using the same amount of the same leucocytes and the same amount of the same bacteria, with a similar amount of *normal* serum (obtained from the blood of a healthy individual), we can in like manner obtain a *bacterial average* of a normal serum under exactly the same conditions as we obtained the bacterial average of the patient's serum.

As has been explained above, we always consider the opsonic index of the normal as 1. Now, to obtain the opsonic index of the patient we use a simple proportion. The normal bacterial average is to the patient's bacterial average as the normal opsonic index (1) is to the patient's opsonic index (or x).

The white blood-cells are obtained for such experiments from any healthy blood. The same cells are, of course, used in both mixtures. The bacteria are collected into a salt solution in suitable amounts. (The exact technique followed in the many different steps is quite accessible in the literature.)

Having a method then of estimating the strength of opsonins in a given serum we are to consider the two statements already made—that (1) it has been found that a patient not improving has usually a low index, and (2) if we raise that index, we can materially assist the patient in the struggle against the specific infection.

Wright has also, as said above, devised a method by which this

index can be raised and maintained. It is this: At least two very important things happen when a pathogenic germ invades a tissue: (1) the number of white blood-cells is increased by what is known as chemotaxis; (2) the opsonins specific for the invading germ are increased in number. Just where the opsonins are manufactured and poured out into the serum is not definitely known. Some think the endothelial cells lining the blood-vessels are their progenitors; others that they come from the fixed connective-tissue cells, and others again believe that the opsonins are elaborated by the white blood-cells themselves. However that may be, when the pathogenic germ *is* introduced, we find that for a time at least the tissue-cells somewhere are stimulated to secrete more opsonins. If this "natural" increase in leucocytes and opsonic power proves strong enough, the invading germ is overcome and the patient's immunity strength or some part of it is raised sufficiently to cause recovery. If, on the other hand, this does not take place, the patient gets worse and the therapeutic effort now is to increase the amount of white cells and opsonins by artificial means. Arguing from the above, and appreciating that although we can raise the number of leucocytes by various means, "this does not avail much," Wright made the extremely important discovery that if we take a growth of the same bacteria that are doing the mischief, and sterilize it so that it cannot do any more harm, and then inject into the patient's tissues this sterilized bacterial suspension, the opsonic strength will, after a primary fall, be raised, and if proper inoculations of such suspension be given at proper intervals, it is possible to maintain the opsonic index at a high level.* This is the basis of vaccine therapy, and the *vaccines* given to-day are suspensions in salt solution of the same bacteria that are causing the patient's infection and that have been sterilized and accurately measured as to dose, etc. When we say that "we treat a patient according to the opsonic index," we mean that we make frequent examinations of the patient's blood, and when we find that this index is low, we inoculate him with a vaccine that will raise this index to the level of, or above that of, a normal index. This is in contrast to the clinical method of the treatment, where no estimations of the index are made, but the vaccines are given at stated intervals and with dosage that seems to be followed by the *most clinical* improvement.

This then is a mere outline of the question of opsonic index and vaccine therapy. There are, of course, very many theoretical, technical, and practical factors that must be carefully considered in each step of the procedure before we can fully explain the status of the question of opsonins and the therapy.

Since the above technique, offering a definite practical therapy, has been brought out by Wright, many men throughout the world

* Of how much real value it is artificially to increase the number of white blood-cells, and wh t method (nucleinic acid, horse serum, etc.) is best, we do not yet know. There is a general tendency to-day toward attributing more and more importance to the phagocyte, and efforts are being energetically made to determine just how and when or under what conditions the greatest phagocytosis takes place in the body of the infected patient.

have been investigating the truth of his suggestions and claims. The great questions have been:

1. Of what importance are opsonins as a factor in immunity?

2. Can we truly estimate the exact content of a given serum in opsonins by this somewhat elaborate technique of Wright's?

3. To what extent should we base our therapy upon the opsonic index, and to what extent upon the clinical findings?

The following will probably cover pretty accurately the present status of our knowledge in attempting to answer the above questions:

1. It is generally admitted that there are in the blood-serum chemico-physical bodies which have been appropriately called opsonins.

2. These opsonins have some specific action on certain bacteria as to render them more subject to phagocytosis.

3. "Normal" sera have pretty definite amounts of opsonic content, which do not vary to any great extent in health.

4. The opsonic content of a serum taken from an infected individual is quite apt to be found without the limits—*i. e.*, either above or below.

5. The value of a number of successive estimations of opsonic content is of distinct diagnostic value as to variety of bacterium causing the individual infection.

6. Administration of the so-called vaccines has a tendency to raise a low index if properly given as to time and interval.

7. Administration of vaccines at suitable intervals and with suitable dosage is very frequently followed by marked clinical improvement.

8. Just what part in the machinery of immunity opsonins play is not yet understood.

9. To exactly what extent we can rely upon the opsonic index (as estimated by our present technique) to be a *true* index of the opsonic factor in immunity we cannot yet say.

10. In spite of the wide-spread tendency to administer the vaccines according to clinical findings it is probably most accurate, in the majority of cases, to follow the index as a guide.

Vaccine therapy based upon opsonins applies, of course, to those bacterial diseases which are combated, mainly at least, by phagocytosis. These include what is known as surgical infections, and are represented, for example, by the streptococcus, staphylococcus, colon bacillus, gonococcus, tubercle bacillus. The blood has no bactericidal or antitoxic effect upon these organisms, and it is *only* by phagocytosis, as far as we know, that these bacteria are resisted.

The best clinical results so far reported have been in chronic localized infections, such as lupus, tuberculosis of bones, joints, and urinary tract. In chronic staphylococcus infections of skin and subcutaneous tissues, as sycosis, boils, carbuncles, and acne, quite marked improvement is often noted. In joints inflamed by the gonococcus and in chronic colon bacillus infections of bladder or kidney occasional cures are to be expected. Marked results are reported in individual cases of infections by streptococcus proteus, influenza bacillus, diplococcus intracellularis, etc.

PRESCRIPTIONS.

A PRESCRIPTION (L. *præ*, for; *scriba*, I write) is an order on the pharmacist to furnish the patient a single remedy or a combination of remedies made into the form desired by the physician. All prescriptions are, then, *simple* if containing but one drug preparation, and *compound* if containing more than one.

The first element of correctness in prescription-writing consists in so forming the prescription that the pharmacist will, without question, understand it as the physician does. Any chance of a wrong interpretation by the pharmacist must be carefully guarded against.

The names of drugs in prescriptions are regularly written in Latin, the advantages of this being that they are without ambiguity, are readable in any part of the civilized world, and are not intelligible to the average patient, who frequently has erroneous preconceived notions of the efficacy of certain drugs.

English names are often ambiguous, for example, the name "snake-root" is applied in different parts of the country to the plants *Cimicifuga racemosa*, *Aristolochia serpentaria*, *Asarum Canadense*, *Eupatorium aromaticum*, *Polygala Senega*, etc.

The parts of the ordinary prescription are:

1. The *name* of the patient, and *date*.

2. The *symbol* ℞ representing the Latin word *recipe*, take thou. This is known also as the *superscription*.

3. The *names and quantities of the ingredients*, known also as the *inscription*.

4. *Directions to the pharmacist:* What he is to do with the ingredients, whether to make them into pills or capsules or a plaster, etc. Known also as the *subscription*.

5. *Directions for the patient.* To be placed by the pharmacist on the label. Known also as the *signature*.

6. The *signature of the physician.*

Example:

For Mrs. B——.[1] July 3, 1899.

℞[2] * Olei morrhuæ, f℥iij;
Vini albi, f℥j;
Glyceriti vitelli, q. s. ad f℥viij;[3]

Fiat emulsio.[4]

Sig. Tablespoonful after meals.[5]

Dr. P——.[6]

* In ancient times it was customary to preface a prescription with a pious invocation to Jupiter or some guardian deity. These prayers were finally abbreviated, until they came to be expressed by the simple astronomical sign ♃, symbol of the planet Jupiter. The upright stroke across the letter R heading modern prescriptions is a curious relic of the above heathen usage condensed in the planetary sign.

Here the small numerals or exponents are (1, 2) the *superscription;* (3) the *inscription;* (4) the *subscription;* (5, 6) the *signature.*

Formerly a typical prescription was said to consist of four divisions:

1. The *basis*, or principle active agent.
2. The *adjuvant*, or auxiliary, to aid the action of the basis;
3. The *corrective*, to correct or modify its action;
4. The *vehicle*, to give proper form or taste to the whole.

But it is not necessary that all prescriptions shall include the above four divisions.

Each ingredient should have a separate line.

Combination of Drugs.

In writing a prescription we assume that it is intended, as should always be the case, to fulfil a single therapeutic purpose only; and we are to decide first, whether the medicine shall be administered in a solid or in a liquid form; and second, whether a single remedy or a combination of remedies shall be prescribed.

The tendency to-day, among many able therapeutists and clinicians, is to prescribe single drugs or simple combinations, while the prescriptions of former times containing a large number of ingredients, the so-called "shot-gun" prescriptions, are good examples of *polypharmacy.* There is, however, danger in going to the extreme of sacrificing therapeutic efficiency to simplicity of form and elegant pharmacy; and it must be confessed that such compounds as Warburg's tincture and the bolus prescribed by Dr. Graves in the treatment of dropsical patients prove the efficacy of polypharmacy in many cases.

As a general rule, we prescribe only one drug to provoke emesis, and a combination of several if we wish a diuretic. A purgative is usually multiple, but if the selection be castor oil or croton oil, it will be single.

After we have selected the basis, or chief ingredient or ingredients, of our prescription, the next point to determine is whether we can add anything which will in any manner be of real assistance to that basis. This ingredient, or adjuvant—as it is called—has usually a physiological action similar to that produced by the basis, as in combining two cathartics or two diuretics to act upon different portions of the intestines or kidneys. Sometimes, however, an adjuvant may differ in its effects—as sulphuric acid serves as an adjuvant to quinine by favoring its absorption and thereby hastening and increasing its action, as mercury assists the action of squills upon the kidneys, or as iron is an adjuvant to a cardiac stimulant.

Having chosen the adjuvant, the next point to consider is whether the action of the drugs selected may not be rendered more kindly through the addition of some other substance as a corrective—that is, to correct some disagreeable effect of the active agents. For example, extract of belladonna or hyoscyamus relieves the griping

occasioned by some of the more violent cathartics, like podophyllin. Other well-known instances of this kind are those of the aromatic spirit of ammonia, which mitigates the unpleasant symptoms of iodism, and hydrobromic acid, which lessens the untoward action of quinine.

Great care and thought should be given not only to the basis, adjuvant, and corrective, but also to the vehicle, which claims equal attention. The *vehicle* is the diluent, generally employed to make up the quantity to a definite number of easily measured doses. It may be a substance with a pleasant flavor or aroma, for a prescription is often rendered more palatable, and no less efficient, by some substance which produces a more agreeable taste. It is a mistaken idea that medicines, in order to be effective, should be repulsive to the patient. The homeopath's success is largely due to the very agreeable taste of his remedies. The mere caprice of the patient, however, should not be considered in the choice of a remedy, when, in the best judgment of the physician, it is indicated. Still, it is well to study carefully the art of prescribing agreeable doses, so far as may be compatible with fidelity to science. It is to be noted that pleasantness of taste is far more important in the case of fluids than in that of solids.

The favorite vehicles are: The aromatic waters, such as anise, cinnamon, peppermint, rose, etc.; the aromatic syrups, orange, orange flowers and tolu; the elixirs, fluidextract of licorice, etc. Some patients dislike sweet mixtures. In many cases simple syrup, glycerin or pure water serves, after all, as the best vehicle, although the physician's choice must be governed mainly by experience.

Other things being equal, a liquid is more rapidly absorbed than a solid preparation; but for exact dosage and convenience in carrying about, pills, capsules, tablets, and powders are favorite forms of administration. These should usually be given with plenty of water to aid disintegration, or to insure their solution or dilution. Many substances administered in pill, tablet, or capsule form will be very irritating to the stomach if given without water, or may fail to disintegrate so that they are passed in the stools unchanged. Tablets with strong irritating properties, like potassium iodide, potassium bromide, or ammonium chloride, should be dissolved in water before administration.

The bitter taste of a remedy may be avoided by administering the drug in capsules, or cachets, or as sugar-coated or gelatine-coated pills; or, if a liquid, by adding syrup of yerba santa or various aromatic or sweetened liquids.

Prof. H. C. Wood, M. D., has written so clearly upon the art of combining, or, more correctly speaking, associating, medicines that we cannot do better than quote his observations *verbatim:*

"The art of combining medicines is not a difficult one, but in practice certain principles should not be lost sight of. Chief of these are, to prescribe as few remedies as possible, and to use no

powerful drug without a very distinct idea of what it is intended to do. Whenever it is desired to give a powerful remedy in increasing doses until its physiological effect is produced, it should always be given by itself. Thus, it may be necessary to give arsenic so as to impress the system, at the same time that iron is indicated; but the two remedies should be given separately, so that the dose of either can be increased or diminished independently of the other."

The principles of combination formulated below were long ago enunciated by Dr. Paris, but are to-day as imperative as ever. Medicines are combined:

"*First.* To augment, correct, or modify the action of a medicine. Thus, purgatives act much more kindly when a number of them are united together. The chief reason of this probably is that, as different remedies affect different portions of the gut, the whole intestine is best reached by a union of the diverse substances. It may take an intense irritation of the mucous membrane to purge as actively as does a mild irritation of both the mucous membrane and the muscular coat.

"There are powerful medicines which act similarly upon some parts of the organism, but dissimilarly upon other parts. By combining such powerful remedies effects can be obtained at the points where the two lines of action cross each other, without influencing to a great extent other portions of the system. Thus, chloral produces sleep by its action upon the brain, and also has a distinct influence upon the heart, but none upon the intestinal tract. Morphine acts upon the brain, and does not influence the heart, but has a powerful effect upon the intestinal tract. By combining chloral and morphine we get an overwhelming conjoined influence upon the brain in producing sleep, with the least possible disturbance of the heart and of the intestinal tract.

"*Second.* To obtain the joint action of two or more diverse remedies. Thus, in a cough-mixture, morphine may be included to quiet the cough, whilst ipecacuanha and squill (in accordance with the first principle) are added to affect the mucous membrane. The application of this principle requires caution, or the practitioner will be led into that chief abomination—polypharmacy. It is worse than futile to attempt to prescribe for every symptom. It is the underlying cause of the disorder, or the under-stratum of bodily condition, which must be sought out and prescribed for simply.

"*Third.* To obtain a special combination which is really a new remedy, or which experience has shown acts almost as a new remedy. Thus, when to potassium iodide in solution corrosive sublimate is added, a new chemical compound (potassio-mercuric iodide) is formed, which experience has shown to be of great value in syphilitic diseases. Griffith's antihectic mixture (mistura ferri comp.) is another instance of the use of chemical changes, the protocarbonate of iron (ferrous carbonate) being formed out of the sulphate of the metal and the potassium carbonate. In the famous Dover's powder no chemical change occurs, but the ordinary action

of opium upon the skin is so enhanced by the ipecac that the combination may be looked upon almost as a new remedy.

"*Fourth.* To afford a suitable form. Thus, acacia is added to make an emulsion, or confection of rose to make a pill. In the choice of excipients care should be exercised to select a substance free from medicinal properties, having no chemical incompatibility with the medicinal agent and of suitable physical character. Bread-crumb often makes a good excipient for pills, but with silver nitrate it is chemically incompatible, on account of the sodium chloride it contains.

"When writing a prescription the utmost care should be taken to use such excipients that the combination should not only be attractive to the eye, but also as little repulsive to the palate as may be. Whenever possible the pill form should be employed with bitter or disagreeable medicines. The pill may be readily coated with silver-foil; tonic pills may be coated with iron by shaking or rolling them in ferri pulvis while soft and sticky. Sugar-coated pills and 'compressed pills' are apt to get so hard and insoluble that their use requires caution. In regard to mixtures, flavoring oils should be freely used, and the power of glycerin to conceal the disagreeable taste of many substances should be remembered."[1]

INCOMPATIBILITY.

When different substances, whether liquid or solid, are combined or associated and undergo a more or less complete change, they are said to be incompatible, the incompatibility consisting of two kinds: chemical and pharmaceutical. (Drugs that are opposed in their physiological action are preferably spoken of as *antagonists.*)

The incompatibles and antagonists of the different substances are fully mentioned under the respective drugs. The principles governing incompatibility, however, may well be considered here.

Chemical incompatibility is of the most importance.

The commonest forms of chemical incompatibility occur under the following conditions:

1. When a new and insoluble salt is formed, resulting from a mixture of solutions of soluble salts. Example (1): mixing solutions of lead acetate and zinc sulphate, both soluble salts, but producing by chemical decomposition a new and insoluble salt, the sulphate of lead; which is precipitated.

2. By the addition of a strong acid to solutions of salts of weak or volatile acids, such as carbonates and bicarbonates, with resulting decomposition. Example (2): ammonium carbonate, the salt of a weak acid radical, added to syrup of squills, containing acetic acid, causes decomposition to take place, with effervescence and the liberation of carbonic-acid gas.

3. Salts of a feeble or volatile base are decomposed by the

[1] *Therapeutics*, 7th ed., pp. 108 *et seq.*

addition of a strong alkali. Example (3): the evolution of ammonia when a strong alkali is added to ammonia alum, and when chloral hydrate is decomposed by alkalies, such as aromatic spirit of ammonia, lime solution, etc.

4. Alkaloids, or their salts, are thrown out of solution or precipitated from their solutions by the addition of alkalies or alkaline salts. Example (4): sulphate of strychnine in solution is precipitated as the insoluble bromide of strychnine by the addition of a larger proportion of potassium bromide. Quinine sulphate is precipitated as insoluble quinine acetate when mixed with a solution of potassium acetate.

5. Tannic and gallic acids and preparations containing them, as well as many other vegetable acids, produce discoloration or precipitation of iron and many of its compounds. Example (5): ink is the best illustration of this incompatibility. Writing fluids are usually combinations of tannic or gallic acid with some preparation of iron. Add the tincture of ferric chloride to tincture of cinchona, and notice the discoloration.

There are certain preparations of iron, like the compounds with ammonium or sodium citrate (see Tincture Ferri Citro-chloride, N. F., tasteless tincture of iron) which produce little discoloration with vegetable astringents, and none at all with vegetable preparations containing no tannic or gallic acid.

Pharmaceutical incompatibility is the production of a sediment by change of solvent without chemical action. Examples: vegetable tinctures of resinous drugs with water, such as tincture of guaiac and water; copaiba and oils with aqueous preparations; spirit of camphor with water; spirit of nitrous ether with mucilage of acacia, etc. The separation or precipitation may frequently be prevented by the intervention of some viscid substance, such as syrup, glucose, glycerin, mucilage of acacia, etc.

The following is a reference-list of the common incompatibles of individual drugs:

SUBSTANCE.	INCOMPATIBLE WITH
Acacia	Alcohol, tinctures; borax; ferric chloride; lead salts.
Acids in general	Alkalies; metallic oxides, carbonates, and halogen salts.
Acid:	
Arsenous	Ferric hydroxide; magnesia; lime water.
Chromic	Organic substances (alcohol, etc.).
Salicylic	Iron compounds.
Tannic	Alkalies, carbonates, and bicarbonates; lime water; chlorine water; albumin; gelatin; alkaloids; salts of heavy metals; iron salts.
Bismuth:	
Subnitrate	Calomel *; sulphur; tannin; sodium bicarbonate (slow evolution of CO_2 gas if moist).
Chloral:	
Hydrate	Alkalies, carbonates *; ammonium and mercury compounds; potassium bromide; alcohol.
Iodine	Ammonia *; alkalies *, carbonates; chloral; metallic salts; starch *.

SUBSTANCE.	INCOMPATIBLE WITH
Lead:	
Acetate	Acacia; acid hydrochloric; acid sulphuric and sulphates; alum *; ammonium chloride; carbonates; lime water; iodine; potassium iodide; sulphides; tannin; zinc sulphate *.
Mercury:	
Bichloride	Potassium iodide *; salts, carbonates; tannin; borax; alkaloids; lime water *.
Mild Chloride (Calomel)	Acids, acid salts; alkalies, carbonates; lime water *; ammonium chloride; iodine; potassium iodide; ferric chloride, iodide; soap; sulphur.
Potassium:	
Chlorate	Acids, mineral; calomel; organic substances; sulphur.
Iodide	Acids, acid salts; alkaloids; iron; lead and mercury salts; potassium chlorate; silver nitrate; chlorine water.
Permanganate	Ammonia, salts; organic substances; alcohol; glycerin; ethereal oils.
Sodium:	
Bicarbonate	Acids, acid salts; alkaloids; bismuth subnitrate; calomel; metallic salts.
Bromide	Acids, mineral; chlorine water; mercury compounds.
Silver:	
Nitrate	All organic substances (alcohol, glycerin, extracts, oils, starch, etc.); chlorides, bromides, iodides; alkalies; acids, hydrochloric and sulphuric.

Those marked with a * are sometimes directed to be compounded for the purpose of effecting some special change or producing new compounds.

Among the above, potassium permanganate forms an explosive mixture with glycerin; so does chromic acid. Chlorates of potassium, etc., explode when triturated with sulphur, tannic acid, or even particles of cork. The strong acids, nitric and sulphuric acids, and especially mixtures of these, react so strongly with volatile oils (hydrocarbons) as to cause explosion. Iodine affects these oils in the same way—fulminates.

It not infrequently happens that the physician intentionally writes a chemically incompatible prescription. "Black wash" (calomel and lime-water), and "yellow wash" (mercuric bichloride and lime-water) are examples. Other instances are such pharmacopœial preparations as liquor ammonii acetatis, mistura ferri composita, liquor magnesii citratis, and Blaud's pills.

ANTAGONISM.

Antagonists are drugs which are opposed to each other in their physiological effects.

Antagonism was formerly known as "therapeutic incompatibility," but, as this latter term has led to confusion, it is now thought best to limit the term "incompatibility" to chemical and physical changes, such as may occur in a prescription, and to give the term "antagonism" to physiological opposition.

No general rule can be laid down for the avoidance of antagonism. Some of our most valuable drugs contain active principles which are physiologically opposed to each other in their action;

instance: jaborandi, which contains two absolutely antagonistic alkaloids, pilocarpine and jaborine, the latter in small quantity, yet sufficient to control the action of the former.

Opium is a conspicuous example of a complex remedy, containing, besides gum, sugar, etc., eighteen different alkaloids, two neutral principles, and two peculiar acids; so that a prescriber of this drug, while he may, perhaps, flatter himself that he is conforming strictly to the present notions of pharmaceutical simplicity, is in effect a polypharmacist of most pronounced type. Moreover, not only are the constituents of opium very numerous, but, like others mentioned, the drug affords in its thebaïne and morphine a further illustration of direct physiological antagonism.

Again, physiological antagonists are often given together, as atropine and morphine, or aconite and digitalis in certain cases of cardiac arrhythmia.

The author cannot too strongly recommend that physicians ignorant of the physiological action of drugs in large and small doses, if they prescribe at all, should avoid including many remedies in one prescription. But, given a competent and thorough knowledge of the action of drugs and the exact condition of the patient, the physician is justified in giving one or twenty drugs in the same prescription, since he is perfectly familiar with the several agents of relief, and can foretell with nicety the effect to be produced by their combination. In all cases a physician should be as certain of the action and strength of the preparations he administers as the surgeon of the aseptic condition of his hands and instruments.

ESTIMATION OF AMOUNTS.

Having decided upon the various ingredients which are to enter into the prescription, the next consideration is the desirable amount of each.

The bottles found in pharmacies have capacities of 1, 2, and 4 fluidrams, and 1, 2, 3, 4, 6, 8, 12, 16, and 32 fluidounces, or 4, 8, 15, 30, 60, 90, 120, 240, 500, and 1000 Cc., and it is wise to prescribe mixtures of these sizes; otherwise, the patient may fear some error from receiving a bottle only partly full, as when a 10-ounce mixture is placed in a 12-ounce bottle.

As a rule, it is better to prescribe small bottles rather than large. Always avoid ordering more of a medicine than the patient will probably need.

Having decided, then, how many doses to order, and the dose of each ingredient, it is a simple matter of multiplication to figure how much of each ingredient shall go in the prescription.

The following is a very simple rule for estimating amounts in Apothecaries' Measure:

In an *eight-ounce* mixture, the dose being a *dram*, take as many *drams* of the medicine as there are wanted minims or grains to the dose. It will be observed that in this case the basis is an *eight-*

ounce mixture, yet it typifies the rule which, when thoroughly understood, may easily be applied to a four-ounce or a two-ounce mixture, one-half or one-fourth as many drams; while if the dose is to be a dessertspoonful, or two drams, it is only necessary to take *one-half* as many drams to an eight-ounce mixture, reducing for smaller mixtures in accordance with the rule. If the dose be a tablespoonful, or four *drams*, *one-fourth* as many *drams* must be taken to an eight-ounce mixture as there are minims or grains to the dose. This rule, while not fractionally exact, is sufficiently accurate for all practical purposes.

Examples: We desire to give an eight-ounce mixture, with a dram for a dose, each dose to contain 12 grains of potassium bromide and 10 grains of chloral, the vehicle to be syrup of orange and water. We have here, then, 64 doses of a dram each: to be exact, therefore, we should have 768 grains of potassium bromide, or 12 drams and 48 grains; but, following the rule, we put in the mixture 12 drams, since we desire 12 grains to the dose. Of chloral we would require exactly 640 grains, or 10 drams and 40 grains, but we use the round number, 10 drams, in the mixture. We see that in each case there is but the fraction of a grain short in the dose.

The prescription would consequently be written as follows:

℞. Potassii bromidi,	ʒxij;
Chloralis,	ʒx;
Syrupi aurantii,	℥iv;
Aquæ,	q. s. ad ℥viij.

M. et. Sig.—Teaspoonful for a dose.

Or, if we wish the medicaments in greater dilution, we may halve the amounts and double the dose, as follows:

℞. Potassii bromidi,	ʒvj;
Chloralis,	ʒv;
Syrupi aurantii,	℥iv;
Aquæ,	q. s. ad ℥viij.

M. et. ft. sol. Sig.—A dessertspoonful for a dose.

The amount of each ingredient thus varies *with* the size of the mixture, and *inversely as* the dose—*i. e.*, the larger the mixture the greater the amount of the ingredients, the dose being the same; and, the larger the dose the smaller the amount of the ingredients, the size of the mixture remaining the same.

When writing a prescription put down first all the ingredients which are to enter into the combination, and, after the last one, which is usually the vehicle, write the whole amount—*i. e.*, if it is to be a four-ounce mixture, write after the name of the vehicle "q. s. ad ℥iv." Then figure the total amount for each ingredient, by multiplying the amount of each dose by the number of doses, and write it down. In other words, decide upon the doses to be given after the medicines have been selected.

The next thing to be determined is the manner in which the

medicine should be measured out to the patient for internal use. A graduated medicine-glass is always preferable to a domestic measure, and should be ordered in all cases. Teaspoons, as well as dessertspoons and tablespoons, vary considerably in size. A teaspoonful, considered to be equivalent to one fluidram, may contain from one-half to two fluidrams; a dessertspoonful, which should be equivalent to two fluidrams, and a tablespoonful, equal to one-half fluidounce, vary almost as much in capacity.

Ordinarily, it is unwise to prescribe medicines to be dropped out, since a drop varies greatly in dimension according to the viscosity and specific gravity of the fluid, the shape, size, and character of the neck and lip of the bottle, the degree of fulness of the bottle, and the steadiness of the hand in dropping.

Drops, therefore, are not accurate measures. Sometimes, however, it is desirable to order medicines in drops, and then it is well to remember that aqueous liquids and fixed oils drop about one drop to the minim, and volatile oils and alcoholic liquids, such as tinctures or fluidextracts, drop about two drops to the minim.

There are exactly 60 minims of any fluid in 1 fluidram, while 60 drops may be greater or less than 1 fluidram, as the following list shows:

	Drops in f℥j (60 M.)	Weights of f℥j Gr.	Gm.
Acidum carbolicum	111	59	3.82
Acidum sulphuricum aromaticum	146	53	3.43
Æther fortior	176	39	2.52
Chloroformum purificatum	250	80	5.18
Creosotum	122	56½	3.66
Fluidextractum belladonnæ	156	57	3.69
Fluidextractum colchici radicis	160	55	3.56
Fluidextractum digitalis	134	62	4.01
Liq. iodi compositus	63	59	3.82
Liq. potassii arsenitis	57	55	3.56
Oleum caryophylli	130	57	3.69
Oleum tiglii	104	50	3.24
Spiritus ammoniæ aromaticus	142	48	3.11
Syrupus ferri iodidi	65	77	4.98
Syrupus scillæ compositus	102	70	4.53
Tinctura aconiti	146	46	2.98
Tinctura belladonnæ	137	53	3.43
Tinctura cantharidis	131	51	3.33
Tinctura ferri chloridi	150	53	3.43
Tinctura nucis vomicæ	140	44	2.85
Tinctura opii	130	53	3.43
Tinctura veratri	145	46	2.98
Vinum colchici seminis	111	54	3.49

LANGUAGE AND GRAMMATICAL CONSTRUCTION OF PRESCRIPTIONS.

A prescription is written partly in Latin, partly in English. The name of the patient and the date should be in English; the superscription in Latin abbreviation; the ingredients in Latin; the directions to the pharmacist in Latin or Latin abbreviations; and the directions to the patient in English or Latin.

A prescription properly and unmistakably written is a cardinal requisite to the successful administration of medicine, no less than to its correct preparation by the druggist. The reasons for the employment of Latin in prescriptions have already been given, and it is well for every practitioner and pharmacist to possess some knowledge of Latin grammar. Still, by the observance of a few simple rules, one wholly ignorant of the language may acquire a proper use of the forms generally adopted; and a little study, aided by constant practice, will soon fix in the memory the peculiarities of gender, case, and number, and the agreement of adjectives, to be met with in all prescriptions.

VERBS.

The imperative singular is employed in the superscription ℞—*i. e., recipe,* "take (thou)," and in certain directions to the pharmacist, as *misce,* "mix"; *divide,* "divide"; *fac,* "make"; *solve,* "dissolve"; etc.

The subjunctive mood, having the force of the imperative, is also used, as *quantum sufficiat,* "as much as may suffice"; *fiat, fiant,* "let be made" (as *fiat mistura,* "let a mixture be made," or *fiant in pilulas,* "let the ingredients be put into pills"); *bulliat,* "let it boil"; *ne repetatur,* "do not let it be repeated," "do not repeat"; *dividendur,* "let them be divided," etc.

A future passive participle is also frequently used: *dividĕndus,* like an adjective agreeing with the noun in gender, case, and number, and signifying "to be divided (into)," as in the order *in trochĭscos dividĕnda* (măssa), "to be divided into troches."

NOUNS.

Latin nouns are declined according to five different plans, and these are known as the five declensions. Four cases are used in prescription-writing: nominative, genitive, accusative, and ablative.

Most nouns ending in *a* are of the *first* declension, are feminine, and are declined as follows:

Singular.

Nominative	—	Olīva	—	Olive (subject).
Genitive	—	Olīvæ	—	of Olive.
Accusative	—	Olīvam	—	Olive (object).
Ablative	—	Olīvâ	—	with Olive.

Plural.

Nom.	—	Olīvæ	—	Olives (subject).
Gen.	—	Olivārum	—	of Olives.
Acc.	—	Olīvas	—	Olives (object).
Abl.	—	Olīvis	—	with Olives.

An exception is Aloe:

Nom. — Áloe.
Gen. — Áloes.
Acc. — Áloen.
Abl. — Áloe.

[The Latin dative and vocative cases are never used.]

Medical nouns of the *second* declension end in *us*, *os* (masculine, except juniperus, prunus, sambucus, and ulmus, which are feminine), or *um*, *on* (neuter), as:

	Singular.		*Plural.*	
Nom.	— Oleum	— Oil (subject).	Olea	— Oils (subject).
Gen.	— Olei	— of Oil.	Oleōrum, Oleum	— of Oils.
Acc.	— Oleum	— Oil (object).	Olea	— Oils (object).
Abl.	— Oleo	— with Oil.	Oleis	— with Oils.

[The genders of nouns are given as a guide to the agreement of adjectives.]

Or

Nom. — Junīperus.
Gen. — Junīperi.
Acc. — Junīperum.
Abl. — Junīpero, etc.

Indeed, all prescription nouns ending in *us* are of the second declension, save seven—rhus, rhois (3d fem.) and the six names of the fourth declension (see p. 641).

The *third* declension does not follow such strict rules as do the others, and its endings are variously modified in their attachments to the root. These modifications are not indicated in the nominative, but are expressed in the genitive, so the nominative and genitive should always be learned together. It should be observed that, no matter what the connecting-links between the roots and the endings may be, the latter are always the same, viz.: in the singular, gen. *is*, acc. *em*, abl. *e* or *i*; in the plural, nom. *es* or *a*, gen. *um*, acc. *es* or *a*, abl. *ibus*. The nouns of the third declension may be grouped as follows:

GROUP I.—Thirty-three nouns ending in *as* make the genitive in *atis*. All are masculine, save Asclēpias (Gen. Asclepīadis), which is feminine, and all are names of salts. Example:

Singular.

Nom. — Nītras.
Gen. — Nitrātis.
Acc. — Nitrātem.
Abl. — Nitrāte, etc.

GROUP II.—

Nouns ending in *ĭs:*

(*a*) Genitive unchanged; all feminine.

Ex. Nom. Căannabis; Gen. Căannabis.

(*b*) Genitive changing into *ĭtis*, all masculine.

Ex. Nom. Ărsenis; Gen. Arsenītis.

(*c*) Genitive changing into *ĭdis*, all feminine.

Ex. Nom. Hamamēlis; Gen. Hamamēlidis.

(*d*) Genitive changing into *ĕris*, one only, masculine.

Ex. Nom. Pŭlvis; Gen. Pŭlveris.

GROUP III.—

Nouns ending in *o*, all feminine except Cărbo, Pēpo, and Sāpo, which are masculine:

(*a*) Genitive ending in *ōnis*.

Ex. Nom. Lōtio; Gen. Lotiōnis.

(*b*) Genitive ending in *ĭnis*.

Ex. Nom. Mucilāgo; Gen. Mucilāginis.

GROUP IV.—

Nouns ending in *x*, masculine or feminine:

(*a*) Genitive ending in *cis*.

Ex. Nom. Bōrax; Gen. Bōracis.

(*b*) Genitive ending in *cis*, and the last vowel of the nominative (*e*) changed to *i*.

Ex. Nom. Rūm*e*x; Gen. Rūm*i*cis.

GROUP V.—

Nouns ending in *r*, masculine or neuter:

Genitive simply adds *ĭs*.

Ex. Nom. Līquor; Gen. Liquōris.

GROUP VI.—

Nouns ending in *a*, all neuter:

Genitive ends in *ătis*.

Ex. Nom. Enēma; Gen. Enēmatis.

GROUP VII.—

Nouns ending in *s*, masculine or feminine:

Genitive ends in *ĭs*.

Ex. Nom. Ădeps; Gen. Ădipis.

GROUP VIII.—

Nouns ending in *l*, all neuter:

(*a*) Genitive simply adds *is*.

Ex. Nom. Chlōral; Gen. Chlorālis.

(*b*) Genitive doubles *l* and adds *is*.

Ex. Nom. Mĕl; Gen. Mĕllis.

Group IX.—

Nouns ending in *n*, all neuter:

(*a*) Genitive ending in *ōnis* (nominative in *ŏn*).

Ex. Nom. Līmon; Gen. Limōnis.

(*b*) Genitive ending in *ĭnis* (nominative in *en*).

Ex. Nom. Sĕmen; Gen. Sĕminis.

[Erīgeron has the genitive Erigerōntis.]

Group X.—

One noun ending in *c*, neuter:

Genitive simply adds *is*.

Ex. Nom. Lăc; Gen. Lăctis.

Group XI.

One noun ending in *us*, feminine: nom. rhus; gen. rhois.

There are only six medical nouns of the fourth declension, cornus and quercus (feminine), and fructus, haustus, potus and spiritus (masculine). They are declined as follows:

	Singular.	*Plural.*
Nom.	— Spīritus.	Spīritus.
Gen.	— Spīritus.	Spīritûm.
Acc.	— Spīritum.	Spīritus.
Abl.	— Spīritu.	Spirĭtibus.

Of the fifth declension we use the ablative *die* of the noun *dies*, a day, as in the expression *ter in die* "three times a day."

The following nouns are usually considered indeclinable: Azedarach, buchu, catechu, condurango, curare, cusso, diachylon, eriodictyon, jaborandi, kino, matico, quebracho, sago, and sassafras.

ADJECTIVES.

These are many and must agree in gender, number, and case with the nouns which they qualify. They are declined like nouns of different declensions, having the same cases and numbers, and may be divided into two classes.

Class I. includes all but fourteen of the adjectives used in prescriptions. The nominative has three distinct endings: *us*, masculine, declined like the second declension of nouns; *a*, feminine, declined like the first declension; and *um*, neuter, declined like the second declension. Example:

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Singular.

	(2d decl.) *Masc.*	(1st decl.) *Fem.*	(2d decl.) *Neut.*
Nom.	Flūidus,	Flūida,	Flūidum.
Gen.	Flūidi,	Flūidæ,	Flūidi.
Acc.	Flūidum,	Flūidam,	Flūidum.
Abl.	Flūido,	Flūidâ,	Flūido.

Plural.

Nom.	Flūidi,	Flūidæ,	Flūida.
Gen.	Fluidōrum,	Fluidārum,	Fluidōrum.
Acc.	Flūidos,	Flūidas,	Flūida.
Abl.	Flūidis,	Flūidis,	Flūidis.

Class II. includes the remaining fourteen adjectives in use. These, with few exceptions, have two, instead of three endings: one in *is* for both masculine and feminine genders, and another in *e* for the neuter. Adjectives of this class are declined like nouns of the third declension. Example:

Singular.

	Masc. and Fem.	*Neut.*
Nom.	Dŭlcis,	Dŭlce.
Gen.	Dŭlcis,	Dŭlcis.
Acc.	Dŭlcem,	Dŭlce.
Abl.	Dŭlci,	Dŭlci.

(The form Dŭlce is sometimes wrongly used for the ablative.)

Plural.

Nom.	Dŭlces,	Dŭlcia.
Gen.	Dŭlcium,	Dŭlcium.
Acc.	Dŭlces,	Dŭlcia.
Abl.	Dŭlcibus,	Dŭlcibus.

The exceptions in nominative endings are—

Singular.

		Masc. and Fem.	*Neut.*
(1)	Nom.	Effervēscens,	Effervēscens.
	Gen.	Effervescēntis,	Effervescēntis.
	Acc.	Effervescēntem,	Effervēscens.
	Abl.	Effervescēnte, or -i,	Effervescēnte, or i.

Plural.

Nom.	Effervescēntes,	Effervescēntia.
Gen.	Effervescēntium,	Effervescēntium.
Acc.	Effervescēntes,	Effervescēntia.
Abl.	Effervescēntibus,	Effervescēntibus.

Singular.

(2)	Nom.	Trīcolor,	Trīcolor.
	Gen.	Tricolōris,	Tricolōris.
	Acc.	Tricolōrem,	Trīcolor.
	Abl.	Tricolōre, or -i,	Tricolōre, or -i.

Plural.

Nom.	Tricolōres,	Tricolōra.
Gen.	Tricolōrum,	Tricolōrum.
Acc.	Tricolōres,	Tricolōra.
Abl.	Tricolōribus,	Tricolōribus.

Singular.

		Masc. and Fem.	*Neut.*
(3)	Nom.	Fōrtior,	Fōrtius.
	Gen.	Fortiōris,	Fortiōris.
	Acc.	Fortiōrem,	Fōrtius.
	Abl.	Fortiōre, or -i,	Fortiōre, or -i.

Plural.

Nom.	Fortiōres,	Fortiōra.
Gen.	Fortiōrum,	Fortiōrum.
Acc.	Fortiōres,	Fortiōra.
Abl.	Fortiōribus,	Fortiōribus.

Numerals as far as *quatuor* are declined like adjectives of three terminations:

Singular.

		Masc.	*Fem.*	*Neut.*
(1)	Nom.	Ŭnus,	Ŭna,	Ŭnum.
	Gen.	Unīus,	Unīus,	Unīus.
	Acc.	Ŭnum,	Ŭnam,	Ŭnum.
	Abl.	Ŭno,	Ŭna,	Ŭno.

Plural.

(2)	Nom.	Dŭo,	Dŭæ,	Dŭo.
	Gen.	Duōrum,	Duārum,	Duōrum.
	Acc.	Dŭos,	Dŭas,	Dŭo.
	Abl.	Duōbus,	Duābus,	Duōbus.

Plural.

		Masc.	*Fem.*	*Neut.*
(3)	Nom.	Trēs,	Trēs,	Trĭa.
	Gen.	Trĭum,	Trĭum,	Trĭum.
	Acc.	Trēs,	Trēs,	Trĭa.
	Abl.	Trĭbus,	Trĭbus,	Trĭbus.

[The *ordinal* numbers, prīmus, secŭndus, tĕrtius, etc., are not used in prescription-writing.]

Conjunctions—Adverbs.

Conjunctions are rare, except *ĕt*, and. Adverbs are very seldom employed, except *bene*, well.

Prepositions.

Three prepositions govern the *accusative* case: *ăd*, to, up to; *ĭn*, into; and *sŭpra*, upon. Others are rarely used.

Two prepositions, oftenest used, govern the *ablative* case: *cŭm*, with, and *prō*, for.

MUCH-USED WORDS AND PHRASES AND THEIR COMMON ABBREVIATIONS.

Ad lĭbitum (*ad lib.*), at pleasure.
Ad saturăndum (*ad sat.*), to saturation.
Ana (*āā*), of each.
Bĕne, well,

Bis, twice.
Bis in die (*b. i. d.*), twice a day.
Cibus, food.
Cochleare medium (*cochl. med.*), a dessertspoon(ful).
Cochleare magnum (*cochl. mag.*), a tablespoon(ful).
Cochleare parvum (*cochl. parv.*), a teaspoon(ful).
Collutorium (*collut.*), a mouth-wash.
Dein, afterward.
Dimidius, half.
Dosus (*dos.*), a dose.
Et, and.
Extende supra, spread upon.
Gradatim, gradually.
Gutta (*gtt.*), a drop.
Guttatim, drop by drop.
Hora, an hour.
In die, daily.
Lagena, a bottle.
Libra, a pound.
Linteum, lint.
Mane, in the morning.
Mane primo, early in the morning.
Mica panis, a breadcrumb.
Non, not.
Nocte, at night.
Numerus, a number.
Numero (*No.*), in number.
Octavius (*O.*), a pint.
Omne die (*o. d.*), every day.
Omne mane (*o. m.*), every morning.
Omne nocte (*o. n.*), every night.
Partes æquales (*part. aeq.*), in equal parts.
Pro re natâ (*p. r. n.*), as required.
Quantum sufficiat (*q. s.*) as much as is necessary.
Quaqua horâ (*q. h.*), every hour.
Quaquâ quattuor horâ (*q. q. h.*), every four hours.
Saturatus, saturated.
Scatula (*scat.*), a box.
Semel, once.
Semissis (*ss.*), a half.
Semidrachma, (*ʒss.*), half a dram.
Simul, together.
Sine, without.
Si opus sit (*s. o. s.*), if necessary.
Statim (*stat.*), immediately.
Tales (*tal.*), such.
Tales doses (*dos. tal.*), such doses.
Tere simul, rub together.
Ter in die (*t. i. d.*), three times a day.

These complete the list of Latin parts of speech, conjugations, declensions, etc., with which the prescription writer is likely to be concerned.

We are now prepared to analyze a simple prescription and understand its elements.

Suppose we wish the druggist to supply three drams of olive oil. We prescribe as follows:

℞.	Olei	Olīvæ	ʒiij.
Rĕcipe, Take	**of oil**	**of olives**	**three drams.**

It must be borne in mind that the direct object of the imperative *recipe* in this example, as well as in all similar cases, is not the word *ŏleum*, but the word *drachmas* representing the *amount* of it prescribed, as indicated by the Roman numerals and the symbol of Apothecaries' Weight, which, written in full, would be *trēs drăchmas* (acc.). In this class of prescriptions, therefore, including nearly all in use, we need consider only the genitive, the accusative, or grammatical object of the verb being expressed in the *quantity* symbolically indicated.

It will be noted, moreover, that the construction, or order, of the Latin words is the reverse of English usage. Yet it is evident that a grocer's clerk, for instance, might well, and frequently does, employ the same mode of expression:

(of) Granulated Sugar, lbs. 10—

a construction precisely analogous to that of the above prescription, which simple form may be taken as a type for all, subject to such modifications as the nature of the drug and the treatment may require.

There are niceties of Latin construction which, to one acquainted with that idiom, will readily occur in scanning the order of words in certain medicinal compounds. Having the sanction of professional usage, the departure from the classic arrangement is of slight importance, and it is certainly in accordance with the clearer, more direct, English form. Instance the construction in what are known as "Galenical Preparations" (an objectionable adjective, by the way, being at variance with the rules of etymology, since the *c* of the derivative is wanting in the parent word *Galen*). In writing these, the nominative—Unguĕntum, Mistūra, Tinctūra, etc.—is placed *first*, as, Unguĕntum Zīnci Oxidi, etc. Oleum Mŏrrhuæ is also an example, and others are not uncommon, apart from the Galenical order.

The practical difficulties in writing prescriptions correctly are largely eliminated by the almost exclusive use of the *genitive*. Yet it is necessary to understand clearly the use of the *accusative* in all cases where the medicine is made into objects, as powders, capsules, etc. The names of such are the immediate *object* of the imperative *rĕcipe*, and cannot be placed in the genitive.

Example:

℞. *Pilulas* (not Pilulārum) Ferri Iŏdidi (No. xii).

Where the mass is mentioned or implied in the prescription the general rule of the *genitive* is followed, as: ℞. Unguenti Bella-dŏnnæ (a portion); and where the terms fīat, fīant are expressed, the *nominative* is naturally used, as, for example,

℞. Măssæ hydrărgyri, gr. xxx;
Fīant pīlulæ No. x.
Sig. Take one at bedtime.

Here *pīlulæ* is the subject of the Latin irregular verb signifying "to be made," no case save the nominative being admissible. We may, however, write "fiat (or fiant) in pilulas No. x," the subject of the verb being the word for ingredient or ingredients (understood).

It has been presumed in the foregoing pages that all prescriptions are to be written in full—a practice which, could it meet with universal acceptance, would not infrequently be of vital importance alike to patient and practitioner. Custom, however,—and in certain cases advantageously—has authorized the extensive use of *abbreviations*, although the dangers of carelessness or ignorance in their employment will be apparent if we consider that, for example, *Ammon.* may mean either Ammonia or Ammoniacum; *Chlor.*, Chlorum, Chloral, Chloroformum, Chloras, or Chloridum; *Hyd. Chlor.*, Hydrate of Chloral or Hydrargyri Chloridum Corrosivum or Mite; *Sulph.*, Sulphur, Sulphas, Sulphidum, or Sulphis; *Zinc. Phos.*, Zinci Phosphas or Zinci Phosphidum.

These are but few of the many instances of ambiguity occasioned by inadvertence or want of familiarity with the full Latin form, or at least its recognized and unmistakable abbreviation.

In conclusion, let the writer of prescriptions be warned against too great haste and a chirography which none but its author can decipher—a deficiency for which he alone is responsible, though the onus may fall upon the luckless druggist or his bewildered clerk.

With regard to form, it has been our object to show that there is really little difficulty in writing good prescription Latin, and where the slightest chance of error exists the ample expression, as we have strongly urged, should be used. A clear, business-like method, deliberately chosen and consistently pursued, will render this important item of the physician's labor simple, agreeable, and efficient.

It is wisest not only that the directions to the patients should be written in perfectly legible English and in full, but that they should contain the exact dose, time for, and method of taking, and, in short, every detail which may be advisable for the patient and nurse to know, clearly and intelligibly expressed. A physician is

seldom justified in writing merely "As directed," the full directions being the only clue to the safety of the medicine. Moreover, verbal instructions to the patient or attendent may be partially or even wholly forgotten, or confounded with directions relating to other matters connected with the case, and thus the welfare of the patient be endangered.

The terms "For external use" or "Shake before using" will be applied by the pharmacist as indicated by the character and use of the prescription, and need not be specified by the physician; but the pharmacist never applies a "Poison" label to a prescription unless specifically directed to do so.

Should it be necessary to prescribe an extraordinary dose of some powerful drug, the name of the remedy should be underscored or attention called to it by a ×, referring to the bottom of the prescription, where should be written: "Large dose intended," or "Dose of above correct," or something to indicate to the pharmacist that the writer is fully aware of the unusual amount, and thus save delay in consulting with the physician—which a careful and competent druggist would otherwise do. Should it, in the opinion of the physician, be undesirable to repeat the prescription, he should write at the bottom, "Do not repeat," or the customary Latin, "Ne repetatur."

In the case of a poor patient the letters *P. P.* after the name will insure the lowest price from the druggist.

Every prescriber should be supplied with suitable prescription-blanks arranged in the form of pads conveniently carried in the pocket, a suitable size being four by five inches. The paper should be of linen, of good quality; otherwise it is liable to become detached from the druggist's files and lost. A convenient form of pad is composed of prescription blanks with interleaves and copying paper, so that the physician may always retain an exact record of the remedies ordered for his patient.

It is certainly advisable for the physician to write his prescriptions invariably in ink, since pencil is easily erased, and a prescription thus perishable would be of little use in medicolegal emergencies. Besides, an unscrupulous druggist who had been careless in compounding the remedy might easily change the pencil instructions to conform to his mistake. Finally, the pencil-writing is always liable to be erased or partially obliterated when carried for some time or subjected to frequent handling.

The prescription-blank should have printed neatly upon one margin or the back the physician's residence and office, together with hours for consultation, and telephone number if he has one. This advertises the physician to some extent in a legitimate way, besides enabling the patient or druggist to communicate with him readily if necessary.

The prescription should always be signed by the writer in full, that professional responsibility and identity may be assured, the academic "M. D." being preferable as a title to "Dr.," which is

applicable to various professions—often of questionable repute and authenticity.

In concluding these practical hints, the author cannot too strongly impress upon the student the importance of always writing as clear, legible, complete, and classical a prescription as possible. In a new community the reputation of the recent graduate is often dependent upon the character of the prescription he writes. The druggist invariably scans his instructions from the new doctor critically, and the laity and the profession will soon learn the young aspirant's proficiency or ignorance by his public committal in a prescription. No matter how able a diagnostician, pathologist, or bacteriologist he may be, if his first effort in *prescription-writing* be illegible, in poor Latin, or for a hopelessly incompatible mixture, the druggist will label, classify, and measure him with the keenness of professional insight; the judgment will go forth quietly; and years of successful practice may not serve to eradicate that first unfavorable impression.

It would be well to remember the following simple rules of good usage in prescription-writing:

1. Solids are weighed, liquids measured.
2. Very potent substances are placed first.
3. Solids are written first in a liquid preparation, and liquids first in a solid preparation.
4. Never employ " ditto " marks.
5. Abbreviation is good usage (1) in the name of the kind of preparation, as elix. for elixir, tinct. for tinctura; (2) in the directions to the pharmacist; (3) in certain well-recognized expressions in the directions to the patient (for example, *t. i. d.* for three times a day); but abbreviation is never allowable when there is possibility of ambiguity.

If in doubt as to what is correct, write in plain English.

GENERAL INDEX.

NOTE.—The bold-face figures indicate the pages on which the drugs are treated *in extenso.*

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CLINICAL INDEX.

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